JOURNAL OF THE AERONAUTICAL SCIENCES

AERONAUTICAL REVIEW SECTION

VOLUME 9 JANUARY, 1942 NUMBER 3

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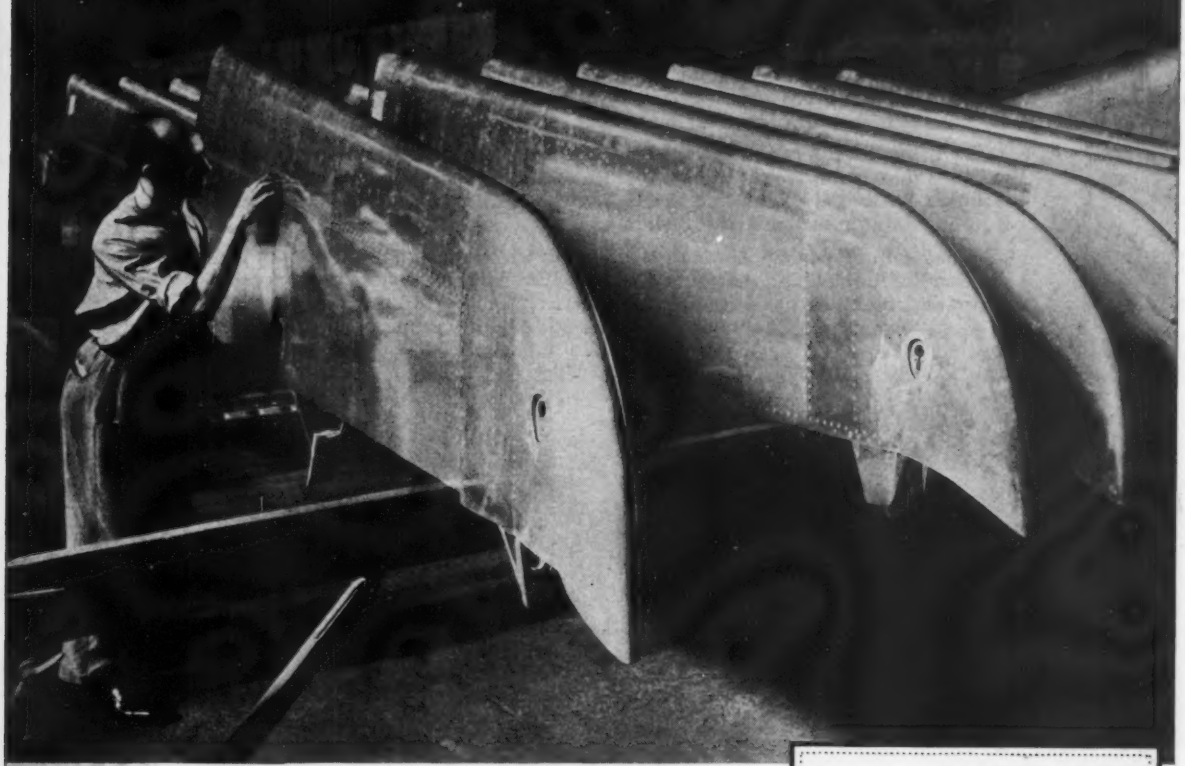

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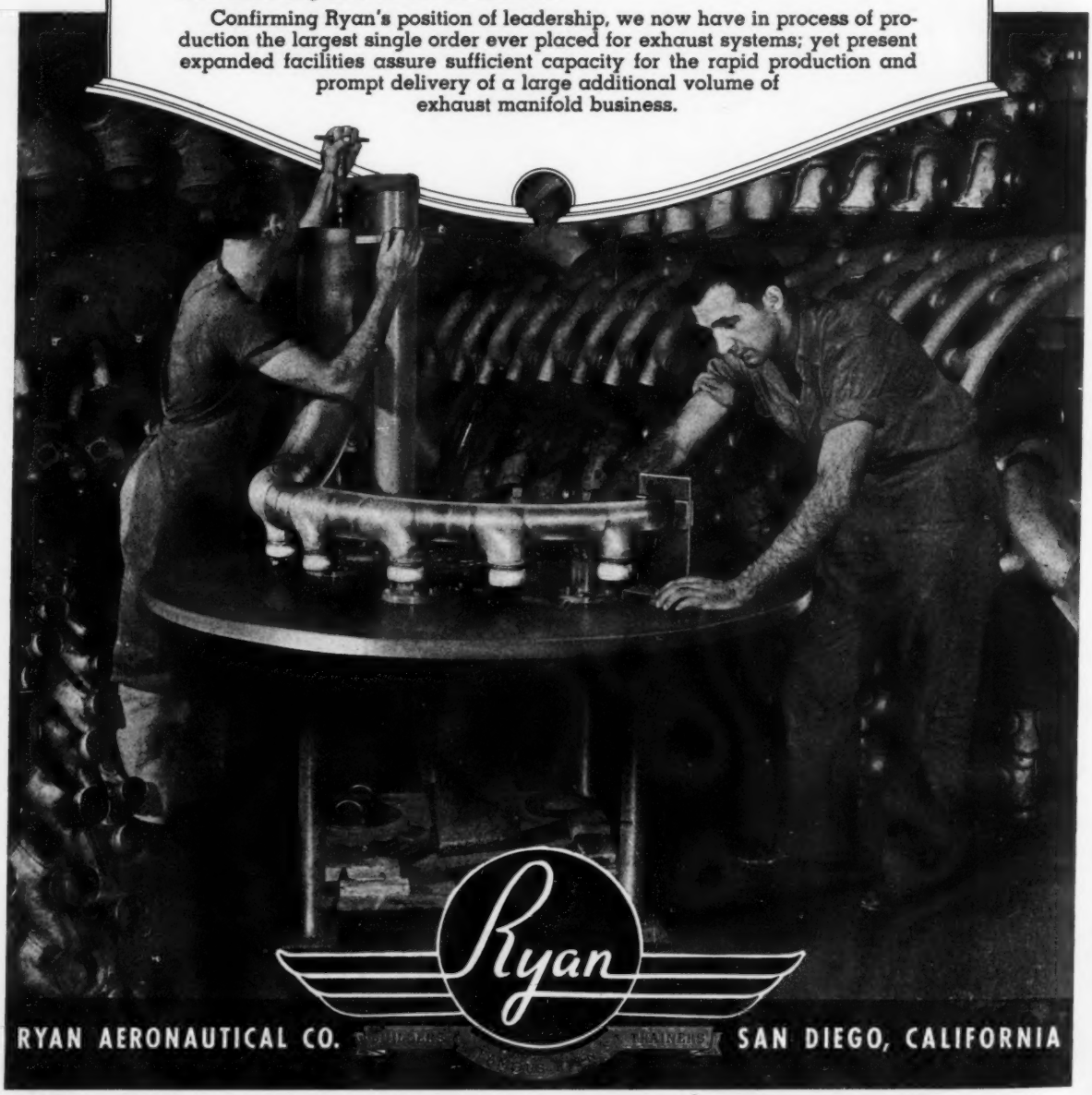

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AERONAUTICAL REVIEW SECTION

JANUARY, 1942

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Library Expansion

THE SERVICES OF THE AERONAUTICAL ARCHIVES of the Institute of the Aeronautical Sciences can now be augmented through two generous gifts made in December.

The Paul Kollsman Library, which loans books, was started in 1940 by a contribution of $50,000 from Paul Kollsman and the Square D Company of Detroit. This fund was to be expended at the rate of $10,000 a year for the upkeep of the Library. The service has far exceeded the hopes of the organizers—so much so that Mr. Kollsman wished to establish the endowment of a permanent fund so that after the end of the five year period the service would not have to be carried entirely by the Institute.

To this end both Mr. Kollsman and the Square D Company have made it possible to create a permanent fund of $65,000, the interest only to be used, yet the same service to be available to borrowing members. It is a most generous attitude and is the direct result of the value which has been rendered by the service to those who wish to secure books by a loan.

The other gift was $25,000 from Mr. Sherman M. Fairchild. It will enable the Institute to publish papers, reports and translations which are too limited in scope to be printed in the trade or technical magazines. During the war some of the reprints will have to be limited in distribution to selected lists of engineers. The principal of the fund is to be used and will make available a large amount of technical information which will, it is hoped, be of assistance to engineers during and after the emergency.

Introducing the Voyenkors

An unfamiliar character in modern warfare is introduced in Lucien Zacharoff's book on the Russian war, *We Made a Mistake—Hitler*, reviewed on page 45 of this issue of the *Aeronautical Review*. He is the *voyenkor*, or Red Army correspondent. Unlike his American or British confrere, he is part of the Army and not an attached civilian. His is a two-way job. He supplies the Army with news of national and civilian activity and acts as military correspondent for official military and civilian publications.

The success of the Russian resistance to German aggression is indicated by Zacharoff to be in large measure the result of the fact that the Army and the people knew what they were fighting about—there has been a constant and persistent liaison between the fighting and production forces of the country, accomplished chiefly through the medium of printed matter. Those who are urging serious curtailment of publications during wartime should examine with care the Russian results before formulating final restrictions.

Make a Habit of Air Cargo

Writing on the growth of air transportation in the United States as a business, Hugh Knowlton, whose book is reviewed on page 48, this issue of the *Aeronautical Review*, propounds that the stock in trade of the air transportation industry is *speed* and that cargo-carrying possibilities will depend on the "carriage of that to which speed is important."

He believes that enterprising traffic departments of the airlines must exploit the possibility of these various fields until the day comes "when the revenue from freight and express will exceed that from passengers, just as in time past the revenue from passengers grew to exceed that from the mail." The implications are that air cargo's future lies ahead and depends even yet upon the exploitation of specific types of cargo.

It is questionable whether, in view of the immense boon to air cargo caused by the demands of the current war and wartime industry in America, the future prognosticated by the writer has not already arrived. The *real* problem of air transportation in the future is more likely to be the maintenance and expansion of the *now established habit* of air cargo.

The history of business and industrial progress is a history of habits—habits improved and revised from time to time. Air cargo, having become a habit through the pyramiding demands of the present emergency, the duration of which is indefinite, it is the business of the air transport industry to exploit this habit to the full—to the end that, come post war, the habit will be so ingrained a factor in the American way of life that even post war equalization and adjustment cannot intervene to erase the air cargo habit now being established.

The obvious way to do this has been pointed out for years past in other industries and has been employed already in the relatively brief career of airlines. Witness the brilliant success of the now almost legendary campaign of directed airline advertising which caused passenger revenue to jump far beyond even mail revenue gains during the past 15 years.

An Appreciation to Corporate Members of the Institute of the Aeronautical Sciences

Listed below are the leading aeronautical and industrial companies who make possible the publication of the *Journal of the Aeronautical Sciences* through Corporate Membership Dues.

The income from these dues enables the Institute to publish scientific and technical papers in the first section of the Journal without advertising and to devote its pages exclusively to editorial material.

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News Review

November 10. The new Pan American Boeing, the Capetown Clipper, left New York on the first passenger-carrying run to the Belgian Congo by way of San Juan, Port of Spain, Belem, Natal, Bathurst, Lagos and Leopoldville.

November 11. Lieut. Carl O. Petersen, U.S.N., member of two Byrd Antarctic expeditions, died of heart disease at the Marine Hospital at Portland, Maine. Petersen was 41 years old.

November 14. The Navy Department announced that a contract for 21 long-range non-rigid airships had been awarded to the Goodyear Aircraft Corporation.

November 14. The Office of Production Management ordered the reporting of all stocks of magnesium not being used in defense production. Stocks thus reported will be sold to approved smelters or producers to be turned over to defense manufacturers.

November 17. Col. Gen. Ernst Udet, Quartermaster-General of the German *Luftwaffe*, was killed while testing a new weapon, it was announced in Berlin.

November 20. The Douglas B-19, flown by Lieut. Col. Stanley M. Umstead, took off with a load of 26,000 lbs.

November 21. Vilhjalmur Stefansson, speaking before the American Philosophical Society, pointed out that the Arctic offers a short cut from Japan and other potential enemy powers.

November 22. Lt. Col. Werner Moelders, Germany's most successful pursuit pilot, credited with bringing down 115 airplanes, was killed in an accident near Breslau.

November 24. Vultee Aircraft, Inc., announced that it had acquired control of Consolidated Aircraft, Inc., by purchasing the interests of Major R. H. Fleet and his family.

November 26. The U.S. *Kitty Hawk*, the first of a group of commercial vessels to be converted into aircraft tenders, was commissioned at the Brooklyn Navy Yard. The craft was formerly known as the *Seatrain*, a 12,000-ton cargo vessel.

November 29. The National Maritime Commission on behalf of the U.S. Navy began negotiations with the United States Lines for the purchase of the ocean liners *America*, *Washington* and *Manhattan* for conversion into aircraft carriers.

November 30. Major General Frank P. Lahm, second U.S. Army pilot, retired from service upon reaching the age of 64.

November 30. Col. Mario di Bernardi test-flew a jet-propulsion airplane 285 miles from Milan to Rome in 2 hours, 5 minutes and 47 seconds.

December 2. LATI, the Italian-operated airline between Pernambuco and Rio de Janeiro suspended operations.

December 3. The Standard Oil Company of Indiana announced the development of a new process for the manufacture of high test aviation fuel which will increase by fifty per cent the quantity of 100-octane gasoline which can be produced from a given amount of synthetics.

December 4. Col. John H. Jouett was re-elected as president of the Aeronautical Chamber of Commerce for the fourth time.

December 5. A Curtiss CW-20, twin-engined 36-passenger transport, was flown to England for shuttle service.

December 6. Regular service between New York and the Belgian Congo by the three-continent route was begun by Pan American Airways.

December 6. The Army Air Forces announces the final acceptance of the Douglas B-19.

December 7. Japanese naval and air forces attacked Honolulu and Pearl Harbor, Hawaii; Manila, and other points on the Philippine Islands; Guam, Wake and other U.S. possessions in the Pacific.

December 8. Japanese aircraft were reported on a reconnaissance flight over San Francisco harbor. Honolulu and various points in the Philippines were subjected to repeated air attack. Some four-engined aircraft, incapable of being launched from carriers, were reported used in the attack, indicating Japanese willingness to sacrifice the equipment in order to deliver a powerful surprise blow.

December 9. A Pan American clipper was attacked and destroyed by Japanese aircraft while at anchor in the harbor of Hong Kong.

Mass training. Trainers used for instrument instruction to flying officers and aviation cadets at the U.S. Army Training Center, Randolph Field, Texas.

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Materials Review—1941

J. B. JOHNSON*

THE AVIATION INDUSTRY is in the throes of a vast expansion which has affected the material supply to such an extent that new developments may be undertaken because it is expedient to satisfy a present shortage rather than to build for future requirements.

The change to all-metal construction, initiated several years ago, began very conservatively by a simple replacement of wood with metal. The ash longerons were changed to thin-walled steel and duralumin tubing, the wing beams to solid aluminum alloy extrusions or sections built up of tube, sheet and extrusions. Gradually, more metal was put into the skin of the wing and fuselage where it could be used most efficiently. Naturally, during this period, plywood, and even a resin impregnated paper, were applied in this monocoque type of construction, and quite successfully; but the trend even in the field of the light, low-powered airplane was definitely toward metal construction.

Then suddenly the metals which had been developed so assiduously were no longer available in the desired quantities. The aviation industry used approximately 35,000,000 lbs. of aluminum in 1939, or eleven per cent of the total production. This year, with a production increased over that of 1939, there is not enough to go around. Stainless steel, which could have relieved this situation, contains eight per cent nickel which is one of the most critical metals in the Defense Program.

Wood and Plastics

It would be extremely difficult, if not impossible, to build engine parts from non-metallic materials. Therefore, since the shortages in metal cannot be eliminated without the construction of new facilities for their manufacture, which requires considerable time, the logical step was to develop non-metals which are suitable for airframe structures. The aircraft industry has always used wood in various forms. In the past few years the applications have been confined to the small commercial and primary military training airplanes. It is still in this field that wood is most extensively used, but there is a gradual expansion to include parts for combat airplanes, such as control surfaces, wing tips, bomb bay doors, nacelle cones, flaps, antenna masts and wing fillets.

Lumber is used principally for solid and laminated wing beams. The former are used only on the smaller airplanes. It is more economical to laminate and splice the shorter lengths, since the cost of aircraft quality lumber increases rapidly with increase in length of the piece on account of the scarcity of relatively slow-growth, straight-grained timber, free from defects.

The strength values for wood (see Table 1) are average values and a certain percentage of pieces will be lower than the allowable design values, whereas in the case of metal the allowable design values are minimum and no piece acceptable under the specifications is below, except in the special case of castings compared to test bars, which is compensated for by a factor of 2.

Sitka spruce is commonly employed since it has the highest strength-weight ratio for a wood which normally can be obtained in adequate quantities. Port Orford cedar and pine are not available in quantity. Fir is a suitable substitute, but carries a weight penalty. Poplar and mahogany are used for veneers. There is a wide variation in the practice of lamination, from the thin strips of $^1/_8$-in. sliced veneer to the $^3/_4$-in. planks. The pieces are generally glued into a solid block and routed out. This type of beam is gaining the preference over the box section, built up with plywood sides and solid flanges, which was popular a few years ago.

In the application of plywood there is a tendency to reduce the amount of framing and increase the thickness of the skin as in the case of metal construction. This has led to the use of preformed or molded plywood which produces a structure with load-deflection characteristics superior to the framed flat panel construction. There are several methods of preforming. The selection of the method is primarily a matter of economics since there is little variation in the resultant product from an engineering standpoint. The plywood may be glued on flat platen presses and formed by steaming and bending, and later glued to the framework. Another method is to wrap successive layers of veneers in strips or sheets around the form, often at oblique angles to the axis of the wing or fuselage, and mold these in place by means of heat and pressure. The material can be used to best advantage by this process since it is possible to make bends with small radii and vary the number of plies to accommodate localized stress concentrations. The latter method has been stimulated by the development of urea-formaldehyde, thermo-setting glues which can be set at relatively low temperatures and without excessive pressure. The phenol-formaldehyde glues, such as the Tego film, used for moisture-resistant plywood, require a pressure of from 150 to 200 pounds per square inch and 280 to 300°F., whereas the urea-formaldehyde, cold setting glues, requiring about the same pressure, will set at 70°F., although higher temperatures accelerate the setting and permit a reduction in pressures. The low pressure permits the use of large containers and a flexible die such as a rubber bag. The pneumatic or hydraulic pressure on the outside of the bag forces the rubber to follow the contour of the piece in a manner similar to that of a rubber die in a hydraulic press.

TABLE 1

Weight and Strength Values for Woods Used in Airplane Construction at 15 Per Cent Moisture Content

(Strength of Aircraft Elements—ANC-5, Table 2-1)

Common Name	Weight, lbs. per sq. ft.	Fiber Stress at Elastic Limit, lbs. per sq. in.	Modulus of Rupture lbs. per sq. in.	Compression Parallel to Grain, lbs. per sq. in.	Modulus Rupture Weight
Spruce	27	6,200	9,400	5,000	3,460
Pine, Western White	27	6,000	9,300	5,300	3,440
Douglas Fir	34	8,000	11,500	7,000	3,380
Cedar, Port Orford	30	7,400	11,000	6,100	3,660
Poplar, Yellow	28	6,000	9,100	5,000	3,250
Mahogany, African	32	7,900	10,800	5,700	3,370
Mahogany, True	34	8,800	11,600	6,500	3,410

The resinous glues are very water-resistant and fungus-proof. Casein glues, although used extensively for assembling parts, have not been wholly satisfactory under semi-tropical conditions due to fungus attack, especially on the inboard section of the wings and the bottom of the fuselage. (See Table 2.)

The durability of plywood construction is largely dependent upon the protective coatings which are applied to the surface in order to prevent rapid changes in moisture content which cause warping and cracking of the outer plies.

* Chief, Materials Laboratory, Materiel Division, U.S. Army Air Corps, Wright Field.

TABLE 2

Type of Glue	Average Shearing Strength, lbs. per sq.in. Birch Plywood Dry	Wet
Casein	400	140
Urea-formaldehyde	400	350

The protective coatings for wood are generally applied in a liquid or semi-liquid form and consist of natural or synthetic resins dissolved in a suitable vehicle, with the addition of mineral pigments, metal powders or chemical compounds to increase the density, hardness, color, stability and hiding power of the films. Since the principal objective is the prevention of the rapid transmission of moisture through the film into the wood, emphasis in testing has been placed on soaking tests. These tests indicate that metal foil, or metal powders which are in the form of flakes which will leaf to form a continuous film, give maximum resistance to passage of moisture. Such films may not give the best results under very dry climatic conditions since the film may blister due to the passage of moisture from the wood out through the film, but for most atmospheric exposures, the highly impervious film gives the best service, provided it is resistant to breakdown on exposure.

Wood may have a moisture content varying from approximately 6 to 16 per cent by weight, under the seasonal climatic conditions existing at aerodromes in this country and its territories. The transfer of equipment from one extreme condition to another is almost certain to cause warping and distortion of structures and surfaces. Organic protective coatings are inadequate and engineers have become interested in methods of impregnation by which the moisture in the wood cells is removed and replaced with a synthetic resin, reducing the moisture absorption below 5 per cent. The weight and strength are increased about in the same proportion.

TABLE 3

Comparative Data on Natural and Compressed Maple

Material	Moisture Content, per cent	Specific Gravity	Percentage of Compression Approx.	Modulus of Rupture in Bending, lbs. per sq. in.
Normal Maple	15.0	0.67	0	15,000
Non-compressed, laminated maple. No impregnation. Tego film bonded	3.3	0.68	0	19,300
Phenolic resin impregnated, compressed, laminated maple. High resin content	3.1	1.37	50	32,800
Phenolic resin impregnated, compressed, laminated maple. Low resin content	3.5	1.29	50	36,900

Suitable methods of fabrication remain to be developed, especially for the forming of curved sections and the joining of component parts of an assembly. Impregnated wood may be compressed and the strength per unit volume increased although the density increases proportionally. (See Table 3.) This scheme has been applied to the construction of wooden propellers.

Materials other than wood, such as fabric and paper, impregnated with the thermo-setting resin, phenol-formaldehyde, have been used for several years for electrical and radio installations, pulleys, cable leads and miscellaneous parts. Attempts have been made to use the sheet material in a manner similar to metal, but it is difficult to form and no satisfactory means of attaching the sheet to the framework has been developed. There is lack of suitable adhesives, and riveting is not satisfactory since the bearing strength of the material is low and cracks may start in service at the edge of the holes. This has been avoided in recent designs for small control tabs by molding the assembly as a unit in a die. Molding has also been applied to fittings. The highest strength-weight ratio and elastic moduli are obtained with the phenol-formaldehyde plastics. Polysterene has been used for molded antenna fittings on account of its superior dielectric properties. It has a low tension modulus but good surface hardness. For super-structures in the nose and tail, and windows in the passengers' compartment, the transparent acrylic plastics are extensively employed. Cellulose acetate sheeting has also been used. It is softer and not so resistant to discoloration from sunlight. The mechanical properties of plastics change with temperature and complete knowledge of these changes must be had if the material is used under load. These materials are apt to become brittle at low temperatures and are subject to creep at low stresses at elevated temperatures.

Steel

Chemical compositions of the steels used in the aeronautical industry have been established over a period of years by a process of adaptation of the fabricating characteristics to satisfy the engineering requirements which have been determined by type or model tests and by actual service. Small changes in the permissible limits for the chemical elements in the specifications may be made in order to obtain larger production of both steel and finished parts. However, substitutions in type cannot be made without due consideration to the effect of the change on forgeability, machinability, processes of heat treatment and similar factors, and on the static and dynamic properties of the finished part, which can seldom be determined by simple laboratory tests on conventional specimens.

The chromium-molybdenum (SAE Type 4100) and chromium-nickel-molybdenum (SAE Type 4300) alloy steels have been most widely used in airframe and engine construction, although smaller amounts of SAE Types 4600 and 3100 are used. The Type 4100 has good weldability, hardens in air to a moderately high tensile strength, with a high tensile-yield ratio and good ductility, and in the form of bar, sheet and tubing is used almost exclusively for steel parts in airframes, with the various heat treatments to obtain the physical properties given in *Strength of Aircraft Elements—ANC-5*. It is fabricated into parts for widely different service conditions such as engine cylinder barrels, landing gear axles and empennage structures. The addition of nickel improves depth hardening, essential for uniform strength over heavy sections. Therefore, the principal applications for Type 4300 are engine forgings and the larger fittings required for landing gears and propellers. Weldability is improved by lowering the carbon content of the alloy steels, but this adversely affects the hardenability unless the other alloying elements are increased. Consequently, the carbon content is increased with increase in sectional thickness with pre-heating prior to welding. Practice indicates that for X-4130, $^{5}/_{32}$ in. is about the maximum thickness for the components of assemblies which are oil-quenched and drawn to an average tensile strength exceeding 150,000 lbs. per sq. in. over the cross-section. For heavier sections it is desirable to increase the carbon, and for sections exceeding $^{1}/_{2}$ in. in thickness, the Type 4300 is preferred.

In the case of the carburizing steels the principal alloys for medium core strength are the chromium-nickel (SAE Type 3100) and nickel-molybdenum (SAE Type 4600), and for high core strengths the chromium-nickel (SAE Type 3300) and 5 per cent nickel (SAE Type 2500). Alloy steel springs are practically all manufactured of chromium-vanadium (SAE Type 6150). Other alloy steels which have been used to a limited extent for special purposes are the Type 6100 for the fabrication of welded propellers and propeller hub forgings, and nitriding steels for parts requiring a maximum surface hardness.

The stainless steels may be divided into two classifications—the austenitic type which cannot be hardened by heat-treatment, and the ferritic type which is hardened by quenching. The former are generally referred to as 18–8 and 17–7 since the principal alloying elements fall within the approximate range of 7 to 11 per cent nickel and 17 to 20 per cent chromium. The type with a minimum of 8 per cent nickel and a maximum of 0.8 per cent carbon is used for service at high temperatures. These steels can be hardened by cold work to over 200,000 lbs.

per sq. in. in thin sections. A stress relieving treatment at 400 to 575°F. for 24 to 72 hours, improves the yield strengths in tension and compression. The degree of hardening with cold work is quite susceptible to the carbon and nickel content and, therefore, the chemical compositions of these steels must be controlled closely to obtain the optimum properties. These steels are easily spot and seam welded with little effect on corrodibility or ductility. When maximum resistance to high temperature or to salt water corrosion is desired, about 3 per cent molybdenum is added. In the case of material for exhaust manifolds operating at temperatures between 900 and 1,400°F., and parts which are fusion welded, a stabilizing element such as titanium or columbium is necessary in order to reduce the intergranular corrosion and subsequent brittleness which may develop in service in the zone adjacent to the weld. The desire to conserve nickel has led to a study of the nickel-chromium-manganese steels. An alloy of 18 per cent chromium, 5 per cent manganese, 5 per cent nickel, has properties comparable with the 18–8 alloys.

On account of the extremely thin material required for small wing sections, which causes buckles and unevenness on the surface of the airfoil, the application of stainless steel has not been so satisfactory although it may be possible to overcome this disadvantage by stretching or other means during fabrication. For larger wings, where the thickness of the sheet can be increased, this difficulty is not apparent. Stainless steel has given very good service on amphibian types of airplanes over salt water, although it is necessary to exercise care in the selection of component parts which are in contact with stainless steel to prevent electrolytic action accompanied by corrosion. It is susceptible to pitting in sulphurous smoke laden atmospheres.

The oil hardening stainless steels are the 13 per cent chromium, 1 per cent nickel, and the 16 per cent chromium, 2 per cent nickel. The latter has somewhat better corrosion resistance. Care must be exercised in the heat-treatment of these steels, since material quenched and drawn between approximately 700 and 1,100°F. has low impact strength and is notch sensitive.

Aluminum Alloys

Aluminum base alloys have changed very little in the past few years. The aluminum-manganese (4S) and the aluminum-magnesium-silicide (51S) alloys used for cowling, wing tips, and fuel lines, have been replaced by other alloys, principally 52S, 53S and 61S. The number of applications of 52S is being reduced to a minimum in order to conserve magnesium. 61S may be satisfactory and less expensive than Alclad 24S for many secondary structures.

Mass production of airframes has stimulated close scrutiny of detailed design in relation to fabricating methods in order to eliminate the labor with hand tools and to reduce the number of operations. Future specifications will place as much emphasis on spring back, bend radii, and suitable grain size, as on tensile properties, since it will be necessary to utilize the large hydraulic presses, stretching machines and drop hammers which are standard equipment in every plant.

Free machining alloy (11S) is used to a limited extent. An aluminum-zinc-magnesium alloy has been used with success for propeller forgings on account of its superior hardness, compared to 25S, which has been the standard alloy for many years, Table 3. The smaller airframe forgings are made of 14S, with some requirements in 17S for somewhat better corrosion resistance when exposed to a saline atmosphere. Very intricate forgings may require an alloy similar to A51S. The alloys for high temperature applications such as engine pistons are 18S and 32S, both of which have proved satisfactory over a wide range of cylinder outputs.

Sand castings have received much attention in connection with new designs and for redesigned parts which were formerly made of forgings. Castings permit a wider latitude of design than other methods of fabrication and can be produced with a minimum of equipment. The allowable design stresses for light alloy castings are lower than for wrought parts, which involves a weight penalty which may be partially compensated for by increased rigidity. The principal disadvantage of castings is the lack of uniformity between individual castings due to the difficulty of controlling a large number of variables entering into foundry practice, although it has been demonstrated that with satisfactory control and indefatigable diligence, sound castings can be produced. The aviation industry has adopted X-ray control and inspection as a means of determining the uniformity of highly stressed castings. The X-ray film is simply a picture of the crass internal structure. Its interpretation requires some experience and should not be attempted without a knowledge of the sections in which exist the major stresses and the general effect of porosity on the physical properties; otherwise, usable castings may be rejected. These are engineering data and do not require the services of a clairvoyant.

Alloy 195, solution treated and aged, is used extensively for airframe castings, although some designers prefer 356 which is more corrosion resistant and has somewhat better castability in intricate sections. Alloy 355 finds its widest application in engine castings for the same reason. Alloy 220 has the highest strength, but it is more difficult to obtain sound castings unless the foundry characteristics are considered in the design.

The aluminum alloys with a coating of high purity aluminum (Alclad) need no protective coatings for normal exposure conditions, but pitting corrosion may develop when scoured with sand and spray from landing on ocean beaches. Bare aluminum alloys are subject to both pitting and intergranular types of corrosion and must be painted. The organic coating which has proved most satisfactory in service is a zinc chromate primer with top coats of lacquer or enamel containing aluminum powder, although many other pigments also give good protection. The adhesion of the primer to the metal is greatly improved by anodizing treatments in chromic acid or sulphuric acid electrolytes. Somewhat less effective, but more rapid and less expensive, are the chemical dipping solutions of sodium-carbonate plus dichromate (Alrok) or chromic acid.

The most vulnerable place for corrosion to start is in a seam or joint. It is quite essential that all lap joints have some inhibiting agent if the aircraft is to operate near salt water. The zinc chromate primer is satisfactory on the faying surfaces for normal operating conditions.

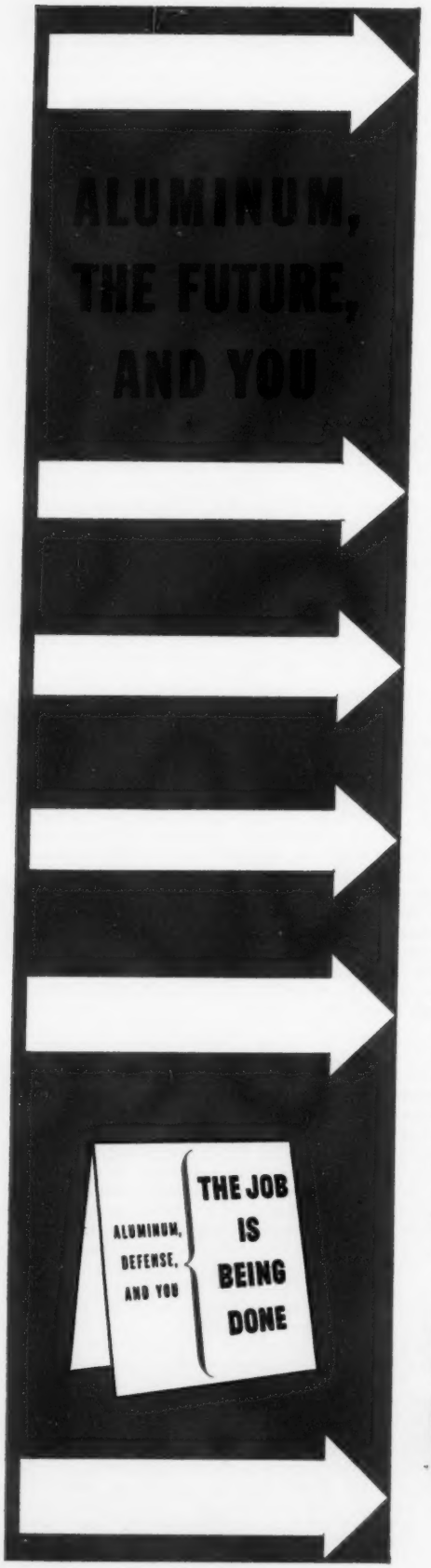
Closely related to the protective coatings are the sealing compounds to prevent fuel and oil leakage in riveted tanks and obtain pressure tightness in fuselage compartments. These compounds must be non-corrosive to the structural metals, non-hydroscopic, non-drying and reasonably elastic as well as resistant to gasoline, oil and the aromatic hydrocarbons. The most satisfactory compounds are composed of a resin dissolved in an ethyl acetate with a suitable plasticizer and zinc chromate pigment. For heavy caulking compounds, asbestos type fillers are added. These compounds will withstand temperatures from −40 to 212°F. without loss of adhesion or embrittlement.

Magnesium Alloys

The magnesium alloys have been curtailed by the limited supply of magnesium ingot to an extent that it has been necessary to change over to aluminum alloys in the case of some landing wheels and castings for low-powered engines. This condition will be alleviated in a relatively short time, since the facilities for producing magnesium are being increased a hundred-fold over the amount consumed by the aviation industry in recent years. In the meantime, research is continuing to improve the alloys. The impurities which cause pitting corrosion have been identified and can be controlled by proper procedures in the melting. The design characteristics of magnesium alloys have never been fully exploited, although a few experimental structures have been tested. It may be anticipated that a wider application will develop with improved methods of fabricating sheet, extrusions and forgings.

Textiles

The materials from which the structural elements are built are few in number, but there is a much larger group of materials required for the accessories and equipment which are used in the operation of the airplane. The textile fibers, natural and artificial, are used for tire fabrics, hose braids, airplane coverings, buffer felts, adhesive tapes and parachutes.



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When the mechanical properties of the fibers are properly balanced to form the cords, fabrics or braids, equally satisfactory performances have been obtained with several applications, for example, cotton and linen fabrics for covering airfoil surfaces; silk, rayon and nylon parachute fabrics; cotton, rayon and nylon tire cords; glass, mineral wool and kapok heat and sound insulation.

Rubber

Rubber, natural and synthetic, may be used interchangeably for certain purposes, but the special properties of some of the latter compounds, chloroprene and butadiene polymers, make their use imperative for parts in contact with hydrocarbons. Several applications are listed as follows:

Rubber	Chloroprene Polymers	Butadiene Polymers
Tires	Hydraulic Cups	Gaskets
Tubes	Carburetor Couplings	Gasoline Resistant Fabric
Shock Absorber Cord	Gaskets	Hose, Solvent
Sponge	Gasoline Hose	
Flexible Tubing	Oil Hose	
Friction Tape	Hose, Solvent	
Water Hose	Heat Resisting Hose	
Spray Hose	Hydraulic Hose	
Vibration Absorbers		

As in the case of other plastics, it is essential that the properties be obtained at the extremes of the operating temperatures, since many synthetic rubbers do not retain their resiliency at low temperatures, and others may creep excessively at elevated temperatures, which in the case of hose for engine coolants is approximately 300°F.

Bibliography

Bearing Metals from the Point of View of Strategic Materials, by H. W. Gillett, H. W. Russel and R. W. Dayton; *Metals & Alloys,* November 1940, pages 629–639; December 1940, pages 749–758.

Cold Forming of High-Strength Sheets; *Light Metals,* November 1940, pages 267–269.

Indium, by J. R. Dyer, Jr.; *Iron Age,* December 19, 1940, pages 35–38.

A System of Routine Radiology, by E. A. Allen and D. Haley; *Light Metals,* November 1940, pages 280–281.

Faults in Light-Metal Castings, by F. Bollenrath and E. Schiedt; *Aircraft Engineering,* November 1940, pages 332–335, 338.

Recent Developments in Magnesium Alloys, by J. C. Mathes; *Journal of the Aeronautical Sciences,* November 1940, pages 24–31.

Compressed Impregnated Timber—Notes on Its Practical Application, by R. M. Lloyd; *Aeroplane,* December 13, 1940, pages 682–684.

Laminated Plastics for Aircraft Parts, by S. W. Place,. *Aero Digest,* January 1941, pages 122, 125, 128, 131.

Elektron in Warfare; *Aeroplane,* November 29, 1940, page 597.

Acoustic Impedance and Sound Absorption, by P. M. Morse, R. H. Bolt and R. L. Brown; *Acoustical Soc. Am. Jour.,* October 1940, pages 217–227.

Anodic Oxidation of Aluminum; *Metal Industry,* November 29, 1940, pages 422–424.

Rubber in Compression, by E. G. Kimmich; *India Rubber World,* December 1, 1940, pages 45–50.

Plastics Used in the Fabrication of Larger Parts of Aircraft, by H. Chase; *Automotive Industries,* January 15, 1941, pages 63–67, 100–101.

Stainless Steel in Aircraft, by R. A. Lincoln; *Iron Age,* January 30, 1941, pages 35–40.

Development of a Plastic Molded Airplane, by H. P. Moon; *Aviation,* January 1941, pages 44–45, 140, 144.

Protection of Magnesium Metals, *Aircraft Production,* December 1940, pages 408–411.

The Surface Treatment of Magnesium Alloys, by H. W. Schmidt, W. H. Gross and H. K. DeLong; *Metal Industry,* January 10, 1941, pages 29–32.

Fluxes for Soft Soldering, by R. G. Harper; *Aircraft Production,* December 1940, pages 393–394.

Cellulose Derivatives as Basic Materials for Plastics, by E. Ott; *Industrial & Engineering Chemistry, Ind. Ed.,* December 1940, pages 1641–1647.

Protein Plastics from Soybean Products, Laminated Material, by G. W. Brothers, L. L. McKinney and W. C. Suttle; *Industrial & Engineering Chemistry, Ind. Ed.,* December 1940, pages 1648–1651.

New Textile Fibers, Fabrics and Finishes; *Industrial & Engineering Chemistry, Ind. Ed.,* December 1940, pages 1543–1571.

Aircraft Cylinder Finishes, by M. A. Coler; *S.A.E. Preprint for Annual Meeting,* January 6 to 10, 1941, 9 pages.

Compounding Plastics and Wood by a New Process, by R. Decat; *Aero Digest,* February 1941, pages 146, 149, 194.

High Strength Alloy Castings; *Aircraft Production,* January 1941, pages 3–4.

Finishing Stainless Steel Welds; *Aircraft Production,* January 1941, pages 32–33.

Age-Hardening Magnesium Alloys, by W. F. Chubb; *Light Metals,* December 1940, pages 306–308.

Magnesium Alloys in the Aircraft Industry, by J. C. Mathes; *S.A.E. Journal (Trans.),* February 1941, pages 76–80. *Aircraft Production,* January 1941, pages 17–18.

Materials Specifications; *Aircraft Production,* January 1941, page 38.

Determining Hardness and Wear Resistance in Light Alloys; *Light Metals,* December 1940, pages 299–305.

War Lessons Influence Development of New Paint Products, by F. W. Fuller, Jr.; *Aero Digest,* February 1941, pages 59–60.

Stainless Steel Fabrication, by F. M. Smith; *Aviation,* March 1941, page 52.

Practical Metallography of the Stainless Steels, by S. P. Watkins; *Metals & Alloys,* February 1941, pages 162–168; March, pages 288–293; April, pages 431–435.

Die Castings in Magnesium Alloy, by H. Chase; *Metals & Alloys,* February 1941, pages 145–150.

Plastics in Review; *Modern Plastics,* February 1941, page 47.

Polyvinyl Alcohol Plastics, by E. S. Peierls; *Modern Plastics,* February 1941, pages 53–56.

Properties of Some Synthetic Rubbers—I, by L. B. Sebrell and R. P. Dinsmore; *India Rubber World,* March 1, 1941, pages 37–40.

Effects on the Static and Fatigue Strength of Materials, by F. Bollenrath; *Luftfahrtforschung,* October 26, 1940, page 320.

Increasing Fatigue Life of Valve Springs by Shot-Blasting; *Automotive Industries,* March 1, 1941, pages 301–302.

Aircraft Plywood and Adhesives, by T. D. Perry; *Journal of the Aeronautical Sciences,* March 1941, pages 204–216.

Pressings in Aeroplane Construction, by E. J. Ritter; *Aircraft Engineering,* February 1941, pages 45–47, 54.

Aircraft Armor—The Protection of Flying Personnel from Hostile Fire, by H. J. Alter; *Army Ordnance,* March-April 1941, pages 497–498.

The Present Status of the Low-Alloy, High Strength Steels—A Survey, by E. F. Cone; *Metals & Alloys,* March 1941, pages 273–283.

New Plastic and Metal Adhesives; *Iron Age,* March 20, 1941, page 67.

Plastics in Aircraft Construction, by W. H. Francis; *Aero Digest,* March 1941, pages 238, 240, 272.

Transparent Coverings; *Aircraft Production,* March 1941, pages 77–78.

Rubbers, Natural and Synthetic, by J. W. Schade; *Journal of the Aeronautical Sciences,* March 1941, pages 177–182.

Advances in Rubber and Plastics During 1940, by F. L. Yerzley and G. M. Kline; *Mechanical Engineering,* March 1941, pages 195–199.

Development of Substitutes for Foreign Textiles Used in Parachutes, by J. Miller; *Rayon Textile Monthly,* March 1941, pages 156–158.

The Manufacture and Uses of "Fiberglas," by G. Slayter; *Rayon Textile Monthly,* March 1941, pages 160–161.

The Compression of Wood, by R. M. Seborg and A. J. Stamm; *Mechanical Engineering,* March 1941, pages 211–213.

The Place of Plywood, Plastics and Corrosion Resistant Steel in Aircraft Construction, by T. H. Huff; *Iron Age,* April 17, 1941, pages 35–40.

Aluminum Casting Alloys for Internal Combustion Engines; *Engineering,* February 7, 1941, page 120.

Process for Surface-Hardening Stainless Steels; *Aero Digest,* April 1941, page 157.

Dilution of Austenitic Welds by Mild Steels and Low Alloys, by R. D. Thomas, Jr., and K. W. Ostrom; *Welding Journal, Welding Res. Sup.,* April 1941, pages 185s–189s.

Magnesium Alloys in Industry, by J. C. Mathes; *The Metal Industry,* March 21, 1941, pages 267–270.

Application of Testing Methods in Aeroplane Construction—Testing of Paint and Varnish Materials, by Kurt Matthaes; *Paint and Varnish Production Manager,* March 1941, pages 79–80.

Cold-Setting Resin Adhesive; *Aero Digest,* April 1941, page 157.

Flammability of Plastic Sheets and Films, by W. A. Zinsow; *Modern Plastics,* April 1941, page 62.

Creep of Neoprene in Shear, by F. L. Yerzley; *Mechanical Engineering,* May 1941, pages 343–345.

Development of Substitutes for Foreign Textiles Used in Parachutes, by J. Miller; *Rayon Textile Monthly,* April 1941, pages 248–249.

Fybr-Tech, a New Material for Airplane Construction, by J. R. Fitzpatrick; *Aero Digest,* May 1941, pages 175–176.

Plywood for Aircraft; *Aircraft Production,* May 1941, pages 161–164.

Standard Treatise on the Ultra-Light Alloys; *Light Metals,* April 1941, page 79.

New Uses of Elektron Sheet, by D. B. Winter, *Aircraft Production,* May 1941, pages 153–155.

The Testing of Metals, by B. Chalmers; *Light Metals,* April 1941, pages 82–86.

Effect of Temperature on Coiled Steel Springs Under Various Loadings, by F. P. Zimmerli; *A.S.M.E. Trans.*, May 1941, pages 363–368.

Creep Behavior of Laminated Synthetic Resin Plastics, by H. Perkuhn; *Luftfahrtforschung*, February 28, 1941, pages 32–37.

Forming and Mounting Acrylic Plastics, by D. S. Frederick; *Aero Digest*, May 1941, pages 195–196.

Plastics in Aircraft—Molding Plastics—Plexiglas Eyes for Our Bombers, by J. E. Simonds and R. Decat; *Aviation*, May 1941, pages 38, 124, 128; 41, 126, 128; 42, 43.

Aluminum Alloy Applications for Major Diesel Engine Parts, by P. B. Jackson; *S.A.E. Preprint for Summer Meeting*, June 1 to 6, 1941, 9 pages.

Beryllium Notes; *Review of Scientific Instruments*, May 1941, pages 286–287.

Formation and Deterioration of Paint Films, by J. L. Overholt and A. C. Elm; *Industrial and Engineering Chemistry (Indus. Edition)*, May 1941, pages 658–660.

Plasticizers for Cellulose Organic Ester Plastics, by W. E. Gloor and C. B. Gilbert; *Industrial and Engineering Chemistry (Indus. Edition)*, May 1941, pages 597–601.

Cold Resistance of Synthetic Rubber, by W. J. McCortney and J. V. Hendrick; *Industrial and Engineering Chemistry (Indus. Edition)*, May 1941, pages 579–581.

Hycar OR—Properties of Typical Compounds, by B. S. Garvey, Jr., A. E. Juve, and D. E. Sauser; *Industrial and Engineering Chemistry (Indus. Edition)*, May 1941, pages 602–606.

Fatigue Limit of Moving Surfaces with Reference to Pitting, by F. Karas; *Zeit. VDI*, April 5, 1941, pages 341–344.

Alternate Materials and Design, by G. F. Titterton; *Aero Digest*, July 1941, pages 148, 241.

Investigation of Materials of Steel Structural Elements Used in Captured Airplanes, by H. Cornelius; *Luftwissen*, March 1941, pages 78–81.

Surface Protection of Metals, by W. Wiederholt; *Zeit. VDI*, May 17, 1941, pages 451–459.

Time and Fatigue Limit Diagrams for Bar-Shaped Structural Members of Cr-Mo-Steel, Duralumin, Hydronalium and Electron, by E. Gassner and H. Pries; *Luftwissen*, March 1941, pages 82–85.

Effect of Bore Holes with Threads and Rudge Teeth on the Fatigue Limit of Light Metal Flat Bars, by H. Buernheim; *Luftfahrtforschung*, March 1941, pages 102–106.

Acrylics in Aircraft; *Modern Plastics*, June 1941, pages 43–45.

Evolution of Safety Glass, by A. F. Randolph; *Modern Plastics*, June 1941, pages 31–38.

Metal Processing in the Aircraft Industry, by R. Sanders; *Aviation*, July 1941, pages 46–47.

Magnesium Sand Castings, by N. M. Briskin; *Iron Age*, July 10, 1941, pages 47–53.

Fatigue Tests on Duralumin, by H. G. Hoskins; *Aircraft Engineering*, May 1941, page 132.

Corrosion of 18-8 Stainless Steel in Sodium Chloride Solutions, by H. H. Uhlig and M. C. Morrill; *Industrial & Engineering Chemistry*, July 1941, pages 875–880.

Painting Magnesium Alloys, by R. I. Wray; *Industrial & Engineering Chemistry (Indus. Edition)*, July 1941, pages 932–937.

Dimensional Changes of Plastics in Boiling Water, by R. L. Wakeman; *Modern Plastics*, July 1941, pages 65–68, 86.

The Flow Properties of Thermo-Plastics, by W. G. Wearmouth; *British Plastics*, May 1941, pages 377–379.

Standardization Sought in Determining Hardenability of Steels—A Symposium, *S.A.E. Journal (Trans.)*, July 1941, pages 266–293.

The Damping Capacity of Steel and Its Measurement, by G. P. Contractor and F. C. Thompson; *The Engineer*, June 13, 1941, pages 388–389.

The Ageing of Aluminum Alloys; *Aircraft Production*, July 1941, page 243.

Beryllium as a Light Metal Component, by C. B. Sawyer; *Metals & Alloys*, July 1941, pages 37–39.

Glass Textiles Enter New Stage, by W. W. Chase; *Textile World*, August 1941, pages 48–50.

Magnesium from Magnesite; *American Chemical Society Journal (News Edition)*, August 10, 1941, pages 839, 841.

Magnesium Alloys—Physical Characteristics, by F. A. Fox; *Metal Industry*, July 4, 1941, pages 2–7.

Possible Substitutes for Nickel Steels; *Automotive Industries*, August 1, 1941, pages 36–37, 50–52.

Causes of Corrosion Currents, by R. B. Mears and R. H. Brown; *Industrial & Engineering Chemistry*, August 1941, pages 1001–1010.

The Drawing of Aluminum, by I. Stewart; *Metal Industry*, July 18, 1941, pages 34–36.

Solders and Soldered Joints; *Automobile Engineer*, July 1941, pages 227–230.

Anodic Coatings on Aluminum, by J. D. Edwards and F. Keller; *Metal Industry*, July 25, 1941, pages 58–60.

Phenol-Formaldehyde Resins and Plastics; *Industrial & Engineering Chemistry*, August 1, 1941, pages 965–975, 980–983.

Rubber-Like Materials; *Journal of American Society of Naval Engineers*, May 1941, pages 460–466.

Textiles Take to the Air, by W. G. Ashmore; *Textile World*, August 1941, pages 44–45.

Phenolic Resins for Plywood, by L. Klein; *Industrial & Engineering Chemistry*, August 1941, pages 975–980.

Recommended Code of Procedure for Fatigue Testing of Hot-Wound Helical Compression Springs, by C. T. Edgerton; *A.S.M.E. Transactions*, August 1941, pages 553–560.

New Fabric Finish Speeds Production, by W. T. Smith and A. B. Marsh; *Aero Digest*, August 1941, pages 175–176, 224, 227.

Developments in Aircraft Control Cables, by C. F. Beed; *Aero Digest*, September 1941, pages 160, 162, 164.

Properties of Aircraft Materials at Low Temperatures; *Metal Treatment*, Quarterly, Summer 1941, pages 55–57.

The Working of Nitriding Steels; *American Machinist*, September 3, 1941, pages 875, 886.

Austenite Grain Size, by A. E. Focke; *Iron Age*, August 28, September 4, 1941, pages 35–40; 51–53.

Use of Manganese in Alloy Steels; *Metallurgist*, August 1941, pages 26–27.

Press Forging Magnesium, by J. P. Thomas; *Light Metals*, July 1941, pages 142–143.

The Protection of Aluminum and Aluminum Alloys, by Elektron; *Aeroplane*, August 8, 1941, pages 158–159.

Reinforcement with Sisal, by A. W. Koon; *Modern Plastics*, August 1941, pages 63–64, 84.

Neoprene Type FR; *India Rubber World*, September 1, 1941, pages 41–42. *Automotive Industries*, September 15, 1941, page 39.

"Thiokol" Synthetic Rubber Type "FA," by S. M. Martin, Jr.; *India Rubber World*, September 1, 1941, pages 30–34.

The Relationship Between Stress and Strain in the Tensile Impact Test, by A. F. C. Brown and N. D. G. Vincent; *Instn. Mech. Engrs. Jour. & Proc.*, June 1941, pages 126–134.

Mechanical Properties of Aluminum Screws, *Light Metals*, August 1941, pages 154–155.

Beryllium Copper in the Aircraft Industry; *Aircraft Engineering*, August 1941, pages 235–236.

High-Strength Vanadium Steel; *Iron Age*, September 25, 1941, page 50.

Transformation Structures of Some Forty Carbon Steels; *Metals & Alloys*, September 1941, pages 318–323.

Permanent Mold and Die Castings Compared, by H. Chase; *Metals & Alloys*, August 1941, pages 153–160.

Permanent Molds; *Automobile Engineer*, September 1941, page 294.

Surface Preparation for Painting Aluminum Alloys on Aircraft, by R. I. Wray; *Aviation*, October 1941, pages 83, 144, 146.

Effects of Impurities in Plating Solutions, by W. R. Meyer; *Metal Industry*, September 5, 1941, pages 154–156.

Aircraft Plastics; *Flight*, August 14, 1941, page 94.

Industrial and Electrical Styrene Shapes, by F. E. Wiley; *Modern Plastics*, September 1941, pages 44, 82.

Static Fatigue Life of Rubber, by S. M. Cadwell, R. A. Merrill, C. M. Sloman and F. L. Yost; *S.A.E. Journal (Trans.)*, October 1941, pages 442–447.

Properties of Some Synthetic Rubbers, by L. B. Sebrell and R. P. Dinsmore; *S.A.E. Journal (Trans.)*, September 1941, pages 368–379.

Shear Strength of Molded Plastics, by J. Delmonte; *Modern Plastics*, September 1941, pages 63–64, 80.

Materials for Electrical Contacts, by J. C. Chaston; *Inst. Electrical Engineers, Jour.*, August 1941 (Part II), pages 276–301.

Airscrew Blade Materials, by K. B. Gillmore; *Flight*, September 18, 1941, pages 168*e–f*, 169–172.

Spectrochemical Analysis of Duralumin Type Alloys, by H. V. Churchill and J. R. Churchill; *Optical Soc. America, Jour.*, October 1941, pages 611–619.

Creep and Cold Flow of Plastics, by J. Delmonte and W. Dewar; *Modern Plastics*, October 1941, pages 73–79, 110.

The Moulding of Thermo-Setting Materials, by P. Grodzinski; *British Plastics*, September 1941, pages 103–105, 124.

Improved Wood Airscrews; *Aircraft Production*, October 1941, pages 355–356.

Plated Aluminum in the Aircraft Industry, by R. F. Yates; *Aviation*, November 1941, pages 84, 146.

Machinability vs. Microstructure of Aircraft Carburizing Gear Steels, by N. E. Woldman and R. J. Metsler; *Iron Age*, November 6, 1941, pages 59–64.

Effect of Shot Blasting on Strength of Metals; *Heat Treating and Forging*, October 1941, pages 516–517, 533.

Plastics Applied to Airplane Structures, by C. F. Marschner; *Mechanical Engineering*, November 1941, pages 787–790.

Temperature Dependence of Young's Modulus of Internal Friction of Lucite and Karolith, by J. S. Rinehart; *Journal of Applied Physics*, November 1941, pages 811–816.

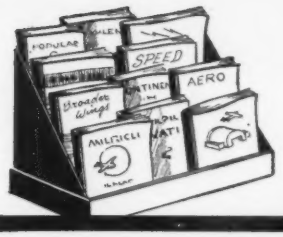
Substitution of Molybdenum for Tungsten; *Mechanical Engineering*, November 1941, pages 798–800.

Twin-Motored Plastic Plywood Plane; *Modern Plastics*, October 1941, pages 52–53, 110, 112.

Corrosion Studies of Magnesium and Its Alloys, by J. D. Hanawalt, C. E. Nelson and J. A. Peloubet; *Metals Technology*, September 1941.

Magnesium Alloys, by A. W. Winston; *The Dow Chemical Company Bulletin* No. DM45.

Stainless Steel, by J. M. Bandel; *The Iron Age*, October 9, 1941.



Periodicals

Accessories

Choosing a Carburettor. D. Ramsay. Points to be considered in deciding make and type and determining the size of aircraft engine carburetors are set out in detail. Curves plotted for the carburetor size for various engine powers show the line of "practical compromise" between power loss and carburetor size. Curves indicate that carburetor size must be increased enormously if the engine is rated at high altitudes and if the loss of power due to pressure drop over the carburetor is to be kept within reasonable limits.

Carburetor size is limited not only by bulk and weight but more particularly by accuracy of metering at ground level. There is a definite limit to the altitude rating of engines to which suction type carburetors may be fitted, and this limit would appear, with present types of carburetor, to be a rated altitude of above 20,000 ft. If the engine is rated at a higher altitude, the carburetor must not be placed on inlet side of supercharger. *Aircraft Engineering*, October 1941, pages 284, 285, 1 illus.

Aircraft Tyres. Recent tire design, production and assembly developments in Britain, America, and Germany are reviewed. Puncture-resistant tires, pressure-chamber packing and sponge rubber filling are discussed. A sectional sketch shows the Witzenmann filler, a German idea, utilizing a sponge rubber filling to delay deflation and safeguard the tire from sudden collapse. *Aircraft Production*, November 1941, pages 9, 10, 1 illus.

The views and opinions expressed in this section are exclusively those of the writers or publications named. They are in no case to be construed as those of the Aeronautical Review or the Institute of the Aeronautical Sciences.

Air Filters for Airplane Engine Protection. William K. Gregory. Preliminary research covering air filters for the protection of airplane engines was reported in the October issue of *Aviation*. This article presents results of further research and discusses definite air filter specifications and a standardized test procedure which differs from that previously followed and reported in the earlier article. *Aviation*, December 1941, pages 115, 206, 207, 3 illus.

Two-Speed Supercharger Drives. F. M. Kincaid, Jr. Summary of a paper in which, by means of illustrations, an exposition is given on the extremely precise manufacturing work required to produce gear assemblies which are of extremely light weight and compact arrangement for the high power transmitted. The American Wright two-speed drive, British Bristol, and Rolls-Royce "Merlin," German Junkers Jumo and Mercedes-Benz units are described in detail together with diagrams and cross-section drawings of the various units done in two and three colors to simplify explanation of their operation. *S.A.E. Journal*, December 1941, page 52.

Will Accessories Impede Our Payload? Summary of a paper delivered by L. R. Hackney. In this paper, the great increase in weight resulting from the considerable increment in accessories on military aircraft is emphasized. The necessity, therefore, for saving every possible ounce of weight in the airplane itself or in its accessories or standard equipment is stressed. Weight-control methods are reviewed and comparative results noted. It is urged that purchasing departments be made more weight-conscious as a more important factor in buying competitive items. *S.A.E. Journal*, December 1941, pages 57, 58.

Aircraft Carburetor Airscoops and Their Effect on Fuel-Air Metering in Flight. F. C. Mock. Summary of a paper in which the location of the carburetor airscoop was discussed with respect to the engine cowling. Another unsolved problem in airscoop design was said to relate to the propeller effect. The work done by Bendix Aviation Corp. to determine what factors control intake airscoop form and location was reviewed. *S.A.E. Journal*, December 1941, pages 16–17.

Turbo-Superchargers for Aeroplanes. I and II. Dr. Sanford Moss, who has been responsible for the de-

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velopment of the turbo-supercharger in the United States offers notes on the principles of the operation of this type of equipment. Supercharging in general is discussed and turbo-superchargers are explained.

The history of turbo-superchargers and the materials of their construction are noted. The method of supercharging for height is pointed out along with the power curves for geared and turbo-supercharges. *The Aeroplane*, November 7, 1941, pages 520–522, 5 illus.

Aerodynamics

Flight in Nature. Frank W. Lane. A discussion of the "structural wonders" of the wings of birds notes comparative air speeds and concludes that insects are supreme masters of flight. Various investigations of bird and insect flight are noted including one on Myotis bats which concluded that the internal ear of the bat serves practically as a "radio locator" when vision is completely obstructed. *Flight*, November 6, 1941, pages 316b–316d, 317, 325, 8 illus.

Gradient-Assisted Take-Off. R. Isermann and E. Beck. A report of take-off tests down slopes of various gradients reaching up to 35°. The experimental results are compared with calculation. The efficiency of this method of take-off, together with its advantages and disadvantages, is examined.

It is concluded that this method of take-off is very economical, effective and reliable in operation. The example calculated, which was chosen intentionally to illustrate the development of the method, is said to show that this method of take-off is sufficient for the highest wing-loadings which are likely in the future. *Aircraft Engineering*, March 1941, pages 68–71, 75, 8 illus.

An Approximate Method to Predict the Transition or "Flare" Flight Path in the Take-off or Landing of an Airplane. Omer Welling. The nature of the transition phase of the take-off and landing of an airplane is briefly discussed. It is shown that, in the usual case, the two maneuvers are virtually identical physically, since in each the airplane may be considered to be a free body being simultaneously accelerated by two mutually perpendicular forces between similar end conditions.

It is also shown that the time histories of the two accelerating forces are in each case so interrelated that one determines the other and that therefore the pilot may control the time history of one of the forces directly, in which case that for the other is automatically determined. Or, the pilot may indirectly control the time history of the other force through his direct control of the one, in which case the necessary time history for the directly controlled force is automatically determined; but he cannot exercise independent control over both forces in any case.

Typical time histories of these forces have been obtained for one airplane in take-off and for two airplanes in landing by means of step-by-step integration of the summation force equations which may be written. From these solutions it appears that the possible time histories which will satisfy a given set of end conditions lie within fairly narrow limits.

Based upon a simple geometrical approximation to the form of these typical time histories, a method is presented by means of which to predict the flight path in terms of the initial and final values of flight path and climbing or sinking speeds and of the thrust and/or drag characteristics of the airplane. *Journal of the Aeronautical Sciences*, November 1941, pages 17–23, 4 illus.

On Propeller-Tip Interference Due to the Proximity of a Fuselage. Albert Gail and Ho-Shen Lu. A theoretic investigation of the periodic changes of the air forces acting on a propeller blade element that passes by the flanks of a fuselage nose. This forcing function known to excite vibrations of propellers and airplane structure is harmonically analyzed. The strength of the fundamental harmonic and the relative strengths of the higher harmonics are found to be greatly dependent upon the location of the propeller plane downstream from the fuselage nose and upon the ratio of fuselage diameter to propeller diameter.

The farther downstream the propeller is located behind the fuselage tip and the greater the fuselage diameter compared to the propeller diameter, the smaller is the intensity of the fundamental harmonic and the smaller is the relative importance of the higher harmonics of these propeller-tip excitations. The clearance between propeller-tip and fuselage flank is found to have comparatively little beneficial effect within the usual limits at the designer's disposal.

The simplifying assumptions of this analysis restrict the validity of the results to fuselage shapes corresponding to a Rankine point-source half-body flow of axial symmetry and propeller locations one fuselage diameter or more downstream from the fuselage bow. Experimental verification of this analysis and an investigation of oblique flow about the fuselage are said to be desirable. *Journal of the Aeronautical Sciences*, November 1941, pages 11–16, 9 illus.

Theoretical Correction for the Lift of Elliptic Wings. Robert T. Jones. A method is presented for theoretical correction lift of elliptic wings. Treatment of the problem of the wing of finite span is on the basis of the two-dimensional theory, corrected for the effect of the wake. According to some approximate calculations (based on the lifting-line theory) made by the writer, the lift of the elliptic wing approaches its final value more rapidly than would be suggested by the two-dimensional theory. *Journal of the Aeronautical Sciences*, November1941, pages 8–10, 3 illus.

The Propagation of Sound Through the Atmosphere. B. Haurwitz. This article gives an elementary survey of the geometrical laws to which sound propagation through the atmosphere is subjected. In a calm atmosphere with decreasing temperature upward, the sound rays are bent upward. If the sound ray returns to the ground, the temperature must increase upward. A wind which becomes stronger with the elevation bends the sound ray back to the ground in the direction of the wind but increases the upward curvature of the sound ray in the opposite direction.

Thus, a region of audibility around a source of sound must be asymmetrical if it is due to the wind. Due to the curvature of the sound rays, aircraft can only be heard within a region well above the visual horizon, the so-called acoustical bowl. The zones of anomalous audibility around an explosion which are separated from the region of normal audibility by zones of silence are to be explained by high air temperatures, of about 340° absolute or more, at around 40–50 km. altitude. *Journal of the Aeronautical Sciences*, December 1941, pages 35–43, 8 illus.

Air Law

El peligro Aereo y la Defensa Militar y Juridica del Territorio (Air Attacks and Military and Juridical Defense of the Country). Rene Gonzales. A study of modern aerial warfare, and of military and civil anti-aircraft defense; also the juridical side of air defense, with reference to international and national law. *Revista de la Fuerza Aerea*, July-August-September 1941, pages 18–32.

Nueva Legislacion Aeronautica (New Aeronautical Legislation). Eduardo Hamilton. Draft of new Chilean

aeronautical legislation which takes into consideration the public right (law and jurisdiction), as derived from international agreements ratified by the government of Chile. *Revista de la Fuerza Aerea*, July-August-September 1941, pages 47–51.

Air Policy

Air Policy and Defense. Edward Warner. The vice-chairman of the Civil Aeronautics Board discusses the highlights of the problems associated with the operation of American aircraft in wartime. The performance of American military aircraft and the service they have given in England are reviewed in the light of considerations which determine the effectiveness of air power's use. *Aviation*, December 1941, pages 48, 49, 186, 188, 2 illus.

Policy and the Air. J. C. Trewin. A discussion of the legislative arguments in both the House of Lords and the House of Commons in England which affected the air strength of England from the close of the first World War to the beginning of the second. *Aeronautics*, August 1941, pages 56–58.

The Business of the Air Ministry. J. M. Spaight. A study of the function, structure and operation of the British Air Ministry. *Aeronautics*, August 1941, pages 35, 36, 1 illus.

Our Warplanes Are Best. Brig. Gen. George C. Kenney. The assistant chief of the Army Air Corps Materiel Division at Wright Field answers typical criticism of United States' military aircraft by self-styled experts. He calls the planes we are getting today the best in the world. Some of the problems in maintaining top notch aircraft types by constant improvement of construction and design are described. *Flying and Popular Aviation*, December 1941, pages 32–34, 68, 96, 97, 8 illus.

Stop Japan Now. James R. Young. A former newspaperman in the Orient outlines the nature of the Japanese threat to American possessions in the Far East and advocates that the United States "call Nippon's bluff." The writer minimizes the strength of Japanese military aviation and suggests that Japan is in a precarious situation in face of the Russian turn against the Axis and the proximity of American air bases. *Flying and Popular Aviation*, December 1941, pages 14–17, 58, 62, 14 illus.

The Question of a Separate Air Force. Cy Caldwell. The writer replies to articles written recently by Rear Admiral H. E. Yarnell and Maj. George Fielding Eliot, opposing the creation of an independent air force. *Aero Digest*, December 1941, pages 70, 73, 74.

Air Power

Russia's Air Force. An estimate of the Russian Air Forces, offering notes on the influence of foreign design and descriptions of the military aircraft types now in service. Russian air strength, still an uncertain factor, is credited with something like a total of 15,000 aircraft, 45 per cent being heavy and light bombers, 40 per cent fighter and 15 per cent reconnaissance. *Flight*, October 23, 1941, pages 274–276, 6 illus.

The Netherlands Indies Are Ready. Maj. Gen. L. H. Van Oyen. The chief of the Dutch Air Force in the Far East describes preparations made in that area to resist attack. Noting that there are many natural deterrents to invasion in the Dutch Indies he gives an account of the military weapons being provided to back up this protection. Equipment and facilities of the air forces are described. *Flying and Popular Aviation*, December 1941, pages 18–20, 70, 72, 9 illus.

Desarrollo de la Aviacion y La Fuerza Aerea (Development of Aviation and Air Power). Dario Mujica. An outline of the history of aeronautics, and of the development of military aviation in various countries, with special consideration of Chile. *Revista de la Fuerza Aerea*, July-August-September 1941, pages 5–17.

Empleo del Avion Como Elemento Ofensivo (Use of the Airplane as an Offensive Element). Oscar Herreros. A technical analysis of the use of air power as an offensive weapon, and its results shown so far in the present war. *Revista de la Fuerza Aerea*, July-August-September 1941, pages 73–84.

Air Transport

Civil Aviation Continuity. R. Brenard. A history of the creation and development of the Koninklijke Maatscgappij voor Nederland en Kolonein N.V., (KLM) tracing its progress from 1920 to the present. *Aeronautics*, August 1941, pages 38–42, 12 illus.

Ocean Air Transport. Juan T. Trippe. A reprint of the entire text of the 29th Wilbur Wright Memorial Lecture delivered before the Royal Aeronautical Society in London on June 17, 1941. The work reviews the history and progress of the Pan American Airways system, presenting its development in equipment, its expansion in service area and the improvements in technique and training which have marked the company's expansion since 1927. *The Journal of the Royal Aeronautical Society*, September 1941, pages 286–315, 19 illus.

Light Ships and Commercial Aviation. Bill Mitcham. A review of the potentialities of the light airplane for commercial transport service. Their use already as equipment for feeder lines is noted with comments on the success of such operations. *Dixie Air News*, November 1941, pages 18, 19, 1 illus.

Status of the Air Transport Industry. W. A. Patterson. The president of United Air Lines surveys the present status of the air mail, passenger and express business of the United States, comparing its progress with that of the automobile industry during a parallel period a generation ago. *Aero Digest*, December 1941, pages 128, 129, 1 illus.

The Future of Civil Aviation. This memorandum, presented by North-Eastern Airways, Limited, examines the advisability of control by an international body and a leading role on the part of Great Britain as alternative solutions to the problem of directing the future of civil aviation. The steps to be taken under either policy are outlined and the pros and cons of each are reviewed. *Flight*, November 6, 1941, pages 318–321, 2 illus.

Airplane Description

Franklin-Powered Monocoupe. Description of the Model 90AF Monocoupe which is similar to its predecessor models except for the installation of the 90 hp. horizontally opposed Franklin engine and other structural and aerodynamic refinements to improve its performance. *Aero Digest*, December 1941, page 236, 2 illus.

The Blackburn Botha. Part I. W. E. Goff. From the engineer's viewpoint the Blackburn Botha is a particularly interesting airplane, owing to its novel type of wing construction and the comprehensive manner in which it has been tooled up for interchangeable production. Constructional details of the Botha and methods employed in construction and assembly are shown in a series of illustrations.

Designed as a general-purpose torpedo-bomber, the Botha is a high-wing cantiliver monoplane of all-metal construction, powered by two Bristol Perseus Mark XA sleeve-valve engines. First produced in 1939, the Botha was built to a specification which was rendered obsolescent by the defeat of France and consequent tactical and strategical changes which became necessary. Since its withdrawal from first-line service, the machine has

been employed as an operational trainer. *Aircraft Production*, November 1941, pages 26–39, 35 illus.

Morrow Plywood Trainer. Brief description of the Morrow plastic-bonded plywood training airplane. The secondary trainer is powered with 175-hp. horizontally operated 6-cylinder lycoming engine. It has a top speed of 165 m.p.h. *Aviation*, December 1941, page 107, 4 illus.

Britain's New "Heavies." A description of the long range, heavy bomber types being increasingly used by the British. This type was pioneered by the United States Army Air Corps. Comparisons are made of some of these British ship types with the Boeing Flying Fortress. *Aviation*, December 1941, pages 104, 105, 218, 6 illus.

Avro Manchester. A brief description of the Avro Manchester heavy bomber as seen through photographs of the airplane in flight and at rest, and of the interior arrangement. *Flight*, November 13, 1941, pages 339–341, 10 illus.

Een Toestel, dat zijn tijd ver vooruit was (An Airplane Which Was Far Ahead of Its Time). At the 15th Paris "Aviation Salon" in 1936 exhibits of the largest airplane factories of Europe were represented; but none of them received so much attention as the Fokker exhibit. It included the Fokker G-1 which 5 years later became the prototype of the best known fighter planes.

This article gives detailed construction data and specifications of this famous airplane, and concludes with a description of one of the test flights during which diving speeds of 650 kilometers were reached (in 1936). *Luchtvaart*, October 7, 1941, pages 366–368, 382, 5 illus.

An Airacobra Squadron. The Bell Airacobra is described as it is used by an R.A.F. Fighter squadron. *Flight*, October 23, 1941, pages 281–283, 9 illus.

Stirling Squadron. A description of typical operations of a bomber squadron using Short Stirlings gives some indications regarding the equipment and performance of this aircraft type. *Flight*, October 23, 1941, pages 276c–278, 10 illus.

High Jump Fighter. Description of the Curtiss 21-B Cyclone-engined interceptor-fighter. *Aeronautics*, August 1941, pages 51, 52, 3 illus.

"Cooked" Craft. I. N. Terry. Descriptive information on the Langley twin-engined low-winged lightplane. *Flying and Popular Aviation*, December 1941, pages 23, 66, 96, 2 illus.

The New Handley Page. A somewhat detailed description of the interior arrangement and equipment of the new Handley Page heavy bomber. Data on design are also given. *The Aeroplane*, November 7, 1941, pages 506, 507, 5 illus.

The irregularity of receipt of publications from abroad necessitates the review of articles in issues several months late. This is done to provide readers with information regarding foreign technical progress as soon as the issues are available in the United States.

World's Deadliest Fighting Ship. A brief, general description of the Bell Airacobra, mostly concerning its armament and fire power. *Popular Science*, November 1941, pages 73, 74, 6 illus.

New Planes for Ocean Travel. David M. Stearns. A brief description of American Export Airlines' new Vought-Sikorsky flying boats which are near completion and expected soon to go into transatlantic commercial service. Some of the newest aids to transocean flying which are installed in these airplanes are characterized. *Popular Science*, November 1941, pages 81–83, 7 illus.

America's Newest Birds of War. Julian Leggett. A review of the newest airplanes added to the equipment of the Army and Navy air services. Various improvements and innovations marking these aircraft as superior to their predecessors are noted. *Popular Mechanics*, December 1941, pages 17–24, 176, 18 illus.

Continental Design Competition. Description of the two winning designs in the 1940 Continental Aircraft Design Competition held annually by the Continental Motors Corp. for Junior Aeronautical Engineering students at the University of Detroit. The first prize winner is a four-place high wing monoplane designed by Henry T. Gieryn, the second prize winner, a tapered, high-wing monoplane called the Cloud Cruiser, submitted by Frank Lewand. *Aero Digest*, December 1941, pages 148, 150, 278, 4 illus.

A German Long-Range Seaplane. The principal feature of interest in the Blohm and Voss Ha.139 4-engine float seaplane, shown in a number of photographs, is the single-spar wing construction. The structure is claimed to be strong, light, and easy to manufacture. A tubular spar is used which takes all torsion, bending and concentrated loads; the ribs are very light as they are only required to carry direct air loads.

Hollow spar is claimed to be particularly advantageous for a machine of this description because catapult points can be welded directly to it; while the concentrated fatigue loads likely to be transmitted from the floats and compression-ignition engines can be taken directly by the spar, without the careful dispersal necessary with a stressed-skin structure.

Another claim made for this type of wing structure is that, once the spar has been made and the rib fixtures attached, the spar itself can be used as the main member for the assembly of the main plane. Wings on the Vogt principle have been built for a number of airplanes, varying in size from the Ha.139 (96 ft. 9 in.) down to a small experimental monoplane with a span of only 19 ft. 8 in.

Engines are the 510-hp. Junkers Jumo 205 6-cylinder, vertically opposed piston, liquid-cooled, compression-ignition type, and are fitted with Hamilton Standard (Junkers License) variable-pitch propellers. Two forms of engine mounting are illustrated. In both cases typical German semi-cantilever mountings are used. It is not known whether any of the Blohm and Voss types have been put into production, but it seems certain they were a government-financed experiment, not only into conditions on the Atlantic routes but also in the development of long range commerce-raiding airplanes. *Aircraft Engineering*, August 1941, pages 218–220, 11 illus.

German Aeroplanes in Service VIII–XI. Continued weekly columns containing drawings and descriptions of the types of German aircraft now in service. Intended as a useful guide to German aeronautical design, the column presents available data on the type, crew, armament, dimensions weights and performance of each airplane. *The Aeroplane*, October 17, 1941, page 431, 6 illus.; October 24, 1941, page 451, 5 illus.; October 31, 1941, page 483, 6 illus.; November 7, 1941, page 509, 6 illus.

The Hard Hitting Hurricane. Notes on the improvements and the modifications made in the Hawker Hurricane since its inception, as an airplane type. Hurricane characteristics are compared to those of other fighters, both British and German, and notes are rendered on the reasons for modifications performed on the design. *The Aeroplane*, October 17, 1941, pages 419–421, 5 illus.

The Bell Airacobra. A description of the Bell Airacobra in the version

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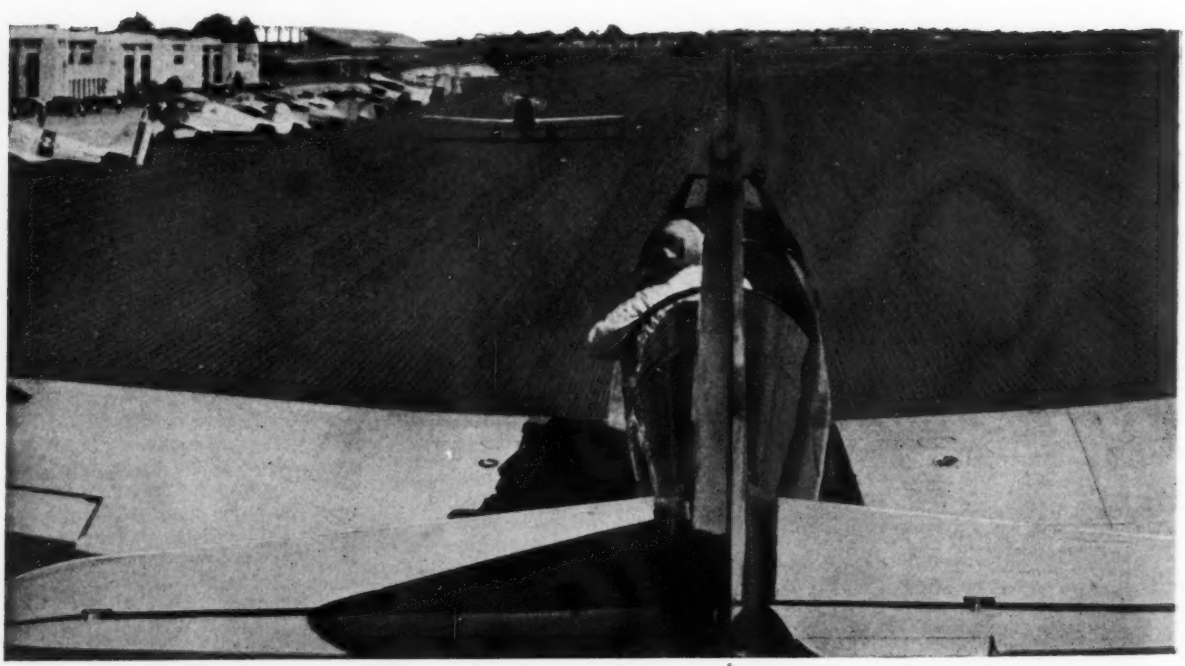


with which a British squadron of single-seat fighters is now equipped and on active service with the R.A.F. Fighter Command. *The Aeroplane*, October 24, 1941, pages 448, 449, 4 illus.

The Morrow Trainer. Description of the Morrow *Victory* trainer, a two-place low-wing monoplane powered by a 175 hp. Lycoming engine. The entire structure of the airplane is of plastic-bonded plywood, and the method by which it is produced is outlined. *Aero Digest*, December 1941, pages 231, 235, 6 illus.

The Northrop "All-Wing" Airplane. John K. Northrop. The president of Northrop Aircraft, Inc., and designer of the Northrop "flying wing" airplane reviews the background out of which the design was developed, including data on the first Northrop wing, initiated in 1923 and first flown in 1928. Unlike the new "all-wing" airplane, the earlier model had movable tail controls on outrigger booms and had but one engine. The essential principle behind the design of the new airplane is explained. *Aviation*, December 1941, pages 82, 83, 184, 202, 6 illus.

Airports

Recent Improvements in Airports Vital to Defense. A survey of enlargements and improvements made in key defense airports throughout the United States. This includes facilities developed in the Connecticut manufacturing district, at Baton Rouge, La., Spokane and Yakima, Washington and Clover Field, Santa Monica, California. *Aero Digest*, December 1941, pages 77, 78, 81, 82, 166, 9 illus.

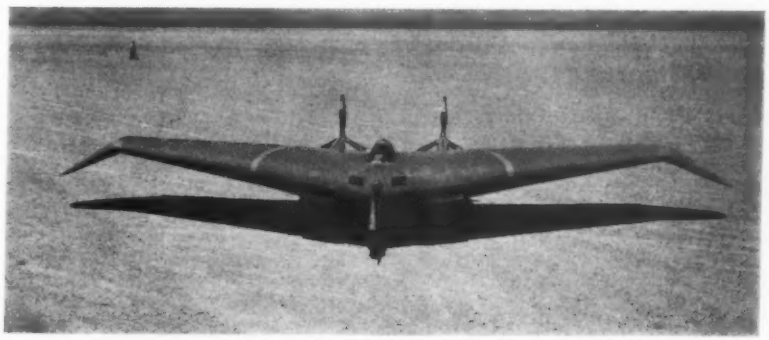
Bombers to Britain. E. Muller. A gigantic Newfoundland airport, location undisclosed, is described as world's biggest airport, and one of the strategic spots in U.S. national defense. Work of transatlantic pilots who ferry bombers to England is described. Possibilities of the Newfoundland airport as a peace-time junction and forwarding point for transatlantic traffic are discussed. *Scientific American*, November 1941, pages 247–249, 2 illus.

Airport Dollars and Sense. A. W. Bernsohn. Calling an airport a business establishment, the writer points out that operators should handle it accordingly. He discusses sources of income and methods for scaling fees. *Flying and Popular Aviation*, December 1941, pages 38–41, 1 illus.

Can America Build Enough Airports. P. O'Malley. An analysis of the program for building 4,000 airports throughout the continental United States to provide facilities for our expanding air forces. Some of the newer methods for the clearing and levelling of ground, and the construction of buildings and runways are described. *Popular Science*, December 1941, pages 102–107, 16 illus.

Progressive Design for a Major Airport. A. B. Lambert. A presentation of five possible runway layouts for a typical major airport. All of these are for the same site. They begin with a simple system and become increasingly intricate, until the last presentation covers two-way landing and taxi facilities in all directions. *Aero Digest*, December 1941, pages 56, 222, 5 illus.

Through German Eyes. Commentary notes on details of the armor and armament on British Aircraft as described by a German engineer in an article in *Luftwissen*, August 1941. The analysis of this equipment on British airplanes brought down in Germany contains, it is said, a certain amount of hitherto unpublished information regarding thickness and amount of armor plate used. But some of the armament details reported are said to be far from accurate. Among the airplane types, the equipment of which is discussed, are the Supermarine Spitfire, Hawker Hurricane, Fairey Battle, Bristol Blenheim, Handley Page Hampden, Vickers Wellington and the Armstrong-Whitworth Whitley V. *Flight*, November 13, 1941, pages 343–345, 4 illus.



A head-on view of the Northrop "Flying Wing."

Armament

I Design Bombs. Hector Bolitho. An interview with Air Commodore Huskinson, the R.A.F.'s expert on the design of aerial bombs. He discusses air missiles, their construction, design and use. He points out the difference between the German and English bombs, indicating that their dissimilarities in basic design indicate a contrasting philosophy in the conduct of warfare. *Air Trails*, November 1941, pages 10–13, 28, 10 illus.

The Development of the Airacobra. The various design stages in the develpment of the Airacobra are reviewed with particular attention to the armament and the manner in which its perfection affected successive design modifications of the airplane. It is noted that the original design, which incorporated a 37-mm. cannon, has been superseded by one 20-mm. cannon which has a far higher rate of fire, two 0.50 guns on the fuselage and four 0.300 machine-guns in the wings. The two applications are fundamentally different, the former being a ground strafer, the latter being a fighter. Details on the present armament of the Airacobra and some figures on the engine and airplane specifications are given. *The Aeroplane*, October 31, 1941, pages 476–479, 4 illus.

Avigation

Navigating Our Big Bombers. Sloan Taylor. An explanation of the navigator's function in the modern long-range bomber, given in an account of a theoretical attack on an enemy aircraft carrier unit, 1,500 miles out in the Atlantic. *Air Trails*, November 1941, pages 20, 21, 30–32, 1 illus.

You Can't Miss It. Idell Durrett Hays. An explanation of the source, composition and use of Civil Aeronautics Authority maps and the care that is taken to keep them up to date and completely informed on changes in contour which are constantly occurring. *Air Trails*, October 1941, pages 19, 26, 28, 1 illus.

Navigation Flight Training. Warren C. Youngclaus. A study of a system by which the student pilot carries the avigation he has learned on ground into the air and makes it an actual part of his flying. The article suggests that the ground avigation training consists of three periods: one devoted to familiarization with the instruments and their functions, a second to the conditions under which the student will be expected to work in the future, and a third to graphical solutions and the use of mechanical computers.

This should be followed by actual cross-country practice with an instructor who checks the student's application of the material he has learned on the ground. The article offers points for instructors to remember in giving cross-country avigation training, as well as the basic factors which the instructor must watch to judge whether or not the student is applying to the fullest possible extent the material he has learned on ground. *Aero Digest*, December 1941, pages, 66, 68, 227, 8 illus.

Eenvoudige Navigatie ten dienste van de Sportvliegers (Simple Navigation for Sports Flyers). J. W. Verhoeven. The twelfth installment of this series treats of dead reckoning and gives calculation examples. *Luchtvaart*, October 7, 1941, pages 380, 381.

Business and Finance

Aviation's Changing Trends. Selig Altschul. A continued discussion by this writer on aviation finance treating of the current position of airline securities as related to Civil Aeronautics Board regulation of the industry and its effect on airline earnings. *Aviation*, December 1941, pages 126, 214, 1 illus.

Design

The Small Airplane and Its Power Plant. W. B. Stout. Opening with a discussion of the writer's work in developing a light airplane of stainless steel construction, most of this paper is devoted to a description of his new engine which is being developed in an effort to achieve the ultimate goal of a 100 hp. engine to weigh 100 lbs. and cost $100. It is designed around the multiple crank shaft introduced some years ago by Jules Dusevoir.

The engine is treated as an interesting experiment and not as an accepted fact at this time. Much operational testing remains to be done before the many novel features will be brought to the point of wide acceptance. *S.A.E. Journal*, December 1941, pages 52, 53.

Development of the Ercoupe. Fred E. Weick. The chief engineer of Engineering and Research Corporation explains the development and background of the Ercoupe, pointing out the objectives sought and the manner in which they were accomplished. Development of a two-place airplane particularly suited to the needs of the private flyer was the aim of the design of the "Ercoupe." This was done by making it unusually simple and easy to fly, quick to learn to fly, and free from the difficulties associated with stalling and spinning; it was also to have a good field of view for the pilot, and a cruising speed of 100 m.p.h. with a low-powered engine.

The development of such a plane began ten years ago when a small group of engineers at the N.A.C.A. Laboratories at Langley Field started a private study that resulted in the construction of the W-1 and W-1A experimental airplanes having certain unconventional features: the tricycle landing gear with castering nose wheel, steerable if desired; suitable longitudinal and lateral stability with definitely limited upward elevator travel to prevent loss of control due to stalling and spinning; a glide-control flap; two-control operation using pitching and rolling controls.

The problem in the case of the Ercoupe was to produce a salable low-powered airplane of good performance and attractive appearance that incorporated the ease of handling and other special characteristics that had been developed in the previous experimental planes. Characteristics of the final design provided with a 65 hp. Continental motor were obtained by a long succession of flight tests, modifications, and more flight tests. Some of the trials and the changes that have been made in the design in order to obtain the flying and handling qualities desired are described. *S.A.E. Journal*, December 1941, pages 521–531, 14 illus.

Post-War "Family" Aircraft. Notes on the type of private airplane likely to be evolved after the present war. A four-place model to sell at around $1,500 is the aim of General Motors Corporation. A suitable type of engine is already on test at the General Motors research laboratories. Also noted is the all-plastic airplane of the Langley Aviation Corporation. *Flight*, October 30, 1941, page 296a, 2 illus.

The Tailless Again. A brief description of the new Northrup flying-wing, prefaced by a review of earlier design theories and efforts in the direction of such a development. *Flight*, November 13, 1941, pages 337, 338, 3 illus.

Unto Caesar. A review of the evolution of the 8-gun fighter, explaining how the Hurricane and Spitfire came to be adopted for fighter types. *Flight*, October 23, 1941, pages 279, 280, 2 illus.

Wing-Weight Estimation. C. R. Englebry. A paper presented by the weight engineer of Lockheed Aircraft Corporation at a recent meeting of the Society of Aeronautical Weight Engineers at Los Angeles. The writer outlines the effect of various items which influence wing weight, and develops a basic formula whereby all conditions are considered. It takes into account variations due to wing loading, span, thickness, taper ratio, load factor and material. Though complex in derivation, its application is said to be simple. *Flight*, October 30, 1941, pages 301–304, 3 illus.

Supporting the Slip-Wing. An interview with Noel Pemberton-Billings in which he replies to a previous interview with Major R. H. Mayo on the comparative merits of the Mayo Composite and the Slipwing. The two theories of assisted take-off are compared in terms of production cost and operating efficiency. *Aeronautics*, August 1941, pages 59, 60, 2 illus.

The Tricycle Undercarriage for Ship-Borne Fighters. Gordon White. A comparative examination of the tricycle and bicycle design of landing gear, indicating some of the characteristics in favor of the three-wheel arrangement which should make it suitable for shipboard use. *Aeronautics*, August 1941, pages 72, 75, 76, 79, 7 illus.

Correct Design of Rigid Structures. Otto Gottschalk. A discussion of structure analysis for correct design of rigid structures. The writer assumes that statics as well as other branches of applied natural science need the visual experiment as a logical and true guidance toward efficient and correct methods of structural analysis, avoiding unnecessary complications and correcting erroneous interpretations.

As an example, the simple visual experiment presented for crossed beams brings out statical conditions that are not being taken into consideration generally, in spite of their importance for the economy and safety against loads and particularly shocks in floor and vault design. At the same time it gives the natural basis for designing two or four-way reinforced slabs.

It is said that the simple equations given represent all the mental tools necessary for the correct analysis of structures; they give results which at present are obtained by the most advanced abstract methods and only by a long series of balancing moments or rotations.

Schemes guiding to proper applications of the visual experiment are given and the conveniences shown of working with fixed points and of analyzing portal structures as straight continuous beams. *Journal of The Franklin Institute*, December 1941, pages 553–578.

Stainless Steel Movable Control Surfaces. George G. Cudhea. The general problems affecting the struc-

tural design of movable control surfaces are discussed. The need for more adequate specifications for the degree of rigidity of the control surfaces is emphasized. Curves are shown illustrating the effect of hinge location on the weight of dynamically balanced surfaces. The use of light airplane fabric for movable control surfaces is suggested.

A short history of stainless steel control surfaces is given. Photographs, weight and dynamic balance data are presented for some typical designs. Deflection data and buckling stresses are shown for tests of ten varying shapes of symmetrical and unsymmetrical leading edge stainless steel nose boxes.

The theory of torsion bending of open sections is discussed and has been applied to the results of tests on thirteen nose box cutouts with varying thicknesses and widths of flanges. The specimens tested consisted essentially of simple channels restrained at the ends by three typical leading edge sections.

Comparative weight studies are presented for the rudders of two large high speed airplanes as designed in aluminum alloy and stainless steel. Calculations showing the relative strengths, rigidities and weights of these surfaces are included. *Journal of the Aeronautical Sciences*, December 1941, pages 44–55, 13 illus.

How to Determine Range. Peyton Autry. Of increasing importance both to designers and owners of airplanes is the problem of range. This article furnishes simple methods for range calculation. *Flying and Popular Aviation*, December 1941, pages 51, 92, 1 illus.

Lofting Problems of Streamlined Bodies. Carter M. Hartley, Roy A. Limong and Edgar Schmued. A study of the method for laying out fuselage lines by the graphical and analytical establishment of second degree curves. This approach was developed and applied by the lofting department of North American Aviation. *Aero Digest*, December 1941, pages 184, 188, 190, 283, 6 illus.

Engines

Avgasenergiens Utnyttjande Pa Flygmotorer (Utilization of Exhaust Gas Energy in Aircraft Engines). Tore Edlen. A review of exhaust gas turbines, the possibility of their application, and the most important problems arising from their use. This first article of the series deals with exhaust gas turbines in general. *Flyg och Motor (Technical Supplement) Flygning*, October 1941, pages I–VI, VIII, 11 illus.

Combustion Research in the U.S.A. Ernest F. Fiock. A review of past progress, present work and future trends in combustion research in the United States. The writer stresses throughout the need for coordination of combustion research and for cooperative support of a continuing program of study. Practical accomplishments in the field are said to have far outdistanced the development of theoretical aspects. *Aircraft Engineering*, August 1941, pages 221–224, 6 illus.

A German View on Allied Engines. P. Koetzschke. Report (translated in full from *Luftwissen*) on five English, three French and two American-manufactured airplane engines. *Aircraft Engineering*, September 1941, pages 149–152, 4 illus.

Oxygen-Boosting of Diesel Engines for Take-Off. P. H. Schweitzer and E. R. Klinge. A report of practical conclusions drawn from an investigation of oxygen boosting of a Diesel engine. Airplanes require about one-third more power during take-off than in flight. In Diesel-engined airplanes, size of the engine could be reduced by 25 per cent by feeding oxygen into the intake air during the take-off. Applying the results of the experiments to a transport airplane shows the possible weigh saving with various oxygen boosts. Curves are based on 6,000 cruising horsepower and an estimated engine weight of 2 lbs./hp.

For take-off, 8,000 hp. are necessary. To supply the additional 2,000 hp., 200 lbs. of oxygen are fed into the intake air during the take-off. The volume of 2,000 lbs. of liquid oxygen is approximately 20 gal. Standard liquid air containers of 55-litre capacity weigh 75 lbs. Therefore, weight of the oxygen and container is 350 lbs., while possible saving in engine weight is 4,000 lbs. The weight per take-off horsepower is thereby reduced from 2 lbs. to 1.54 lbs. The calculation is tabulated.

Oxygen addition may be used for starting Diesel engines. Raising of the oxygen concentration from the normal 21 per cent to 45 per cent was found to be equivalent to a raise of approximately 10 cetane numbers, as far as starting is concerned. Five per cent increase in oxygen concentration eliminated exhaust smoke completely. *The Engineer*, August 8, 1941, pages 90–92, 22 illus.

1,500 h.p. Ford V-12. Harry Wilkin Perry. Details are given on the new air-cooled engine being developed by the Ford Motor Company. It is said that the incorporation in the design of direct fuel injection and turbo-supercharger will provide a really up-to-date motor. It is noted that the Ford engineers are apparently not sufficiently convinced of the superiority of the sleeve valve to include it in the design. *Flight*, November 13, 1941, pages 338g, 338h, 2 illus.

Laboratory Control for Ranger Engines. Clinton B. F. Macauley. A discussion of the manner in which extensive laboratory control of materials and methods makes for constant improvement in quality and performance of Ranger Aircraft engines. *Aviation*, December 1941, pages 108, 109, 190, 192, 10 illus.

Flight Technique

Theory of the Turn. Lieut. Laurence F. Motl. An explanation of the physics and aerodynamics involved in turning an airplane, given from the viewpoint of the flying instructor who must explain this to students. *Aero Digest*, December 1941, pages 210, 213, 214, 3 illus.

The Pylon Eight. John R. Hoyt. An explanation of the manner in which to accomplish the pylon eight, one of the most difficult flight test maneuvers. Its factors and the procedure for it are described. *Flying and Popular Aviation*, December 1941, pages 45, 46, 74.

I Learned About Flying From That!—No. 31. Devon Francis. A description of one of the writer's experiences in learning to fly "the hard way." The account involves a problem of navigation and threatening weather. It is suggested that it is best not to try and beat such weather—the smart pilot will stay on the ground. *Flying and Popular Aviation*, December 1941, pages 46, 80, 83.

Flight Testing

Testing the World's Biggest Bomber. Lt. Col. Stanley M. Umstead. Some of the tests to which the Douglas B-19, largest military airplane in the world, is being put in order to rate and gage its capacities and limitations are outlined in brief. *Popular Mechanics*, November 1941, pages 28–31, 172, 173, 9 illus.

Fuels and Lubricants

Extreme Pressure Lubricants. G. L. Simard, H. W. Russell, and H. R. Nelson. Lead naphthenate plus free sulphur oils on metal surfaces tend to form lead sulfate under mild treatments (low temperatures, short heating periods, or low loads) and lead sulfide under more severe conditions. Surfaces of hypoid gears operated 20,000 miles exclusively in this lubricant consisted mainly of iron oxide and a phase believed to be a leadrick form of lead sulfide.

"WAR DRESS" by John Hammer

WAR DRESS . . . High flying, with oxygen gear, is a dressy affair. Oxygen-fed men and supercharged engines rule the upper air . . . and none will fly higher than the elite pilots of the Army's interceptor commands in mighty 2,000-h.p. Republic P-47 Thunderbolts. Republic Aviation Corporation, Farmingdale, Long Island, N. Y.

REPUBLIC AVIATION

REPUBLIC AVIATION

Lead naphthenate oils produced an amorphous film on metals of either adsorbed lead naphthenate or of an oxidized product of lead naphthenate. Iron surfaces treated with free sulphur oils formed a superficial film of iron oxide. Results are discussed in light of recent theories of boundary lubrication. *Industrial and Engineering Chemistry (Indus. Edition)*, November 1941, pages 1352–1359, 4 illus.

Response of Aircraft Fuels to Tetraethyllead. A. G. Cattaneo and A. L. Stanly. The ethyl blending chart for evaluating lead response of gasolines in the A.S.T.M.-C.F.R. engine has been extended into the region above 100 octane number. Extension is consistent with the original chart in that the line representing the response of a given fuel is continuous and of constant slope throughout its length. The extended chart permits a quantitative measure of lead susceptibility throughout the range from 0 octane number to iso-octane plus 3 cc. of tetraethyllead per gallon. *Industrial and Engineering Chemistry (Indus. Edition)*, November 1941, pages 1370–1373, 8 illus.

Home-Produced Fuels for Oil Engines. Report of an investigation on the possibilities of providing and utilizing home-produced fuels for Diesel engines. Tests covered straight products and the increase in their usefulness by increased doping or blending. Bench tests were carried out on a single-cylinder engine.

In calculating test results, the volumetric efficiency of the engine was taken as 0.86 at 700 r.p.m. and the ratio of the specific heat as 1.35. A graph shows relation between critical ignition temperatures of the various fuel blends and the engine compression ratio under running temperature conditions. *The Engineer*, August 29, 1941, pages 138–140, 1 illus.

Aviation Vapor-Lock Investigation—Cooperative Fuel Research Committee Report. A review of a paper supported by illustrating slides detailing the current work of this committee. It is brought out that test procedures have been further developed and investigation has been carried into the hydraulic liquid field in addition to fuel research. *S.A.E. Journal*, December 1941, page 54.

Development of Oil Dilution. T. W. Siers. A description of the oil dilution system for the starting of aircraft on the bush routes in cold weather. Details are given on the cold weather starting device invented in the United States and adapted by T. W. Siers for successful use in northern Canada. It is based on the Worth principle of oil dilution for aircraft engines. *Canadian Aviation*, October 1941, pages 33, 34, 40, 2 illus.

Fuel Feed at High Altitude. W. H. Curtis and R. R. Curtis. The laboratory work which has been done in investigating problems of fuel feed up to altitudes of 40,000 ft. is reviewed. A detailed report is presented on a specific investigation of the efficiency of a centrifugal pump located at the fuel tank in retarding vapor lock in the fuel line. Effect of dissolved air in the fuel is treated as well as fuel vapor pressures. *S.A.E. Journal*, December 1941, page 51.

Machine Tool Lubrication. An outline of the general aspects of machine tool lubrication with a description of the procedure for keeping various machine tools and parts properly lubricated. *Canadian Aviation*, October 1941, pages 60, 62, 65, 4 illus.

History

Prophet. M. S. Lord. Before 1900 a little-known aeronautical pioneer, Lyman Gilmore, Jr., was experimenting with the monoplane, tractor propellers, and retractable landing gears. The story of this man's efforts to devise a flying machine and his contributions to aeronautics are described. *Flying and Popular Aviation*, December 1941, pages 31, 83, 84, 2 illus.

Clement Ader. A review of the achievements of the flight pioneer, Clement Ader, on the occasion of the 100th anniversary of his birth. *Flygning*, October 1941, pages 12, 13, 2 illus.

Canada's First Air Training Plan. Frank H. Ellis. A reminiscent article by a pioneer Canadian pilot on the history of Canada's first air training plan and its progress during the first World War. *Canadian Aviation*, October 1941, pages 29, 30, 3 illus.

Flying Machine . . . 1873. Diana Sherwood. The story of Charles ("Crazy") McDermott, scholar and visionary who worked for 39 years to perfect a practical flying machine. The results of his efforts are described. *Yankee Pilot*, December 1941, pages 10, 11, 15, 2 illus.

Hydraulics

Hydraulic System Installations. James E. Thompson and Rodney B. Campbell. The second in a series on aircraft hydraulics, this installment explains the power circuit of an aircraft hydraulic system, presenting the general problems of design and installation of the pumps, reservoir, regulators, accumulators and other parts of the power system. *Aero Digest*, December 1941, pages 130, 132, 134, 136, 278, 8 illus.

Bristol Hydraulics. A review of the evolution of the Hydraulic system and its application to the Power-operated Gun Turret. The development of the general system and of the gun turret with retractable cupola are described. *Flight*, November 20, 1941, pages 362–364, 6 illus.

Performance of a Jettison System. M. J. Brennan. Hydraulic performance is investigated and the effect of venting is analyzed. Expressions are derived for determination of time to jettison a given quantity of fuel. Curves indicate average values of losses in pipes and in bends; values of k for various values of k_A and k_v; values of H_v for circular and rectangular tanks; and outlet diameter necessary, when venting system, loss coefficients, available equivalent constant head and rate of flow required are given. *Aircraft Engineering*, September 1941, pages 247–249, 6 illus.

Icing

Icing Problems in Aircraft-Engine Induction Systems. L. B. Kimball. This paper emphasizes the need to make use of protected air intakes for icing conditions, drawing the intake air from inside the engine compartment and in the rear of the engine; also the need for better ice indicators—indicators of icing conditions before ice has actually started to form.

Three specific design recommendations are advanced with respect to the induction system: There should be no change in the aspect ratio of sections of the intake below the carburetor which would tend to prevent escape of ice formations which had been loosened from the metal surfaces. There should be a slight draft in the downstream direction so that ice may fall off the passage walls more readily. There should be no nuts, bolts, bulbs or other protuberances into the air passage which might tend to hinder removal of ice formations. A flush type intake air thermometer bulb has been developed and was shown. *S.A.E. Journal*, December 1941, pages 17, 18.

Formacion de Hielo en los Carburadores (Ice Formation in Carburetors). Gustavo Herrera. A technical study on ice formation in carburetors, its causes, and its prevention. *Revista de la Fuerza Aerea*, July-August-September 1941, pages 52–62.

Study Icing Problems of Transport Aircraft. R. L. McBrien. A discussion of the exhaustive practical test of de-icers under various icing conditions. The data presented are based on a collection of trip icing logs covering individual experiences of scheduled flights of United Airlines Transports over a period of 5 winter seasons. Findings of interest to pilots and airline operators are analyzed and reviewed. *Canadian Aviation*, October 1941, pages 21–23, 36, 38, 42, 44, 14 illus.

Inspection

Evaluation Methods for "Defective" Driven Rivets. Frank D. Klein, Jr. A study of the common defects in driven aluminum alloy rivets, reviewing the general riveting process, the approved and required heat-treating and quenching processes, and aging and storage considerations. Through a series of photographs and explanations, the cause and prevention of common rivet defects are presented. *Aero Digest*, December 1941, pages 154, 158, 162, 214, 11 illus.

Airplane Quality Control. J. W. Dunn. Major points of quality control in the order of their importance are stated as being safety, performance and interchangeability. Subcontractor or vendor inspection is a new factor which has increased tremendously in the past year. The best method of handling this is to set up resident inspectors in national subcontract plants. An inspection manual serves as a guide for all inspectors. A salvage department is vital in preventing wasteful rejection of parts which can be saved. *S.A.E. Journal*, December 1941, page 57.

Instruments

Instruccion de Vuelo (Flight Instruction). Adirio Jessen. An elementary discussion of blind flying, and the instruments necessary for it. *Rivista de la Fuerza Aerea*, July-August-September 1941, pages 42–46.

Alloys for Instruments. O. F. Hudson. A review of the properties of various alloys as they relate to suitability of these materials for use in the manufacture of instruments. The alloys discussed are examples of those having properties particularly suitable either for structural parts or special components of instruments. Included are aluminum and magnesium alloys and alloys for springs, electrical resistances and for permanent magnets. Also noted are alloys of high magnetic permeability and of a low coefficient of expansion. *Journal of Scientific Instruments*, November 1941, pages 211–216, 2 illus.

A Recording Wind Direction Indicator. D. C. Gall. A description of a recording wind indicator in which the angular direction of the wind vane electrically controls an ink record at any distance. The record is in rectangular co-ordinates and provides for an overlap of 90° in the orientation of the vane to allow for fluctuations in wind directions. Details are given on the mechanism to effect this overlapping record. *Journal of Scientific Instruments*, November 1941, pages 219–221, 3 illus.

When "George" Takes Over. Part II. This continuation reviews procedures and methods for testing and operating the Sperry Automatic Pilot. *Canadian Aviation*, October 1941, pages 25, 26, 42, 44, 3 illus.

Lighter-Than-Air

Gas Bags on Patrol. The uses to which lighter-than-air craft are put as a means of maintaining patrol over land and water are outlined in this article which describes roughly the construction of such craft, their operation on patrol and the form of instruction being given to crews which man them. *Popular Mechanics*, December 1941, pages 50–53, 164, 11 illus.

Tin Blimp. John W. Higgins. Historic note on the development of the Navy's ZMC-2 metalclad blimp, the oldest operating rigid airship in the world. Its design and construction are noted along with data on experiments, tests and trial flights connected with its development. *Flying and Popular Aviation*, December 1941, pages 21–22, 2 illus.

Materials

A New Synthetic Material. Among the new synthetic materials now available, Pytram is particularly suitable to the conditions governing aircraft manufacture. Although it may be classed as a plastic, such a definition is not strictly accurate, as components made from this material are not formed in molds under pressure but are built up in layers. Pytram consists of cellulose-fiber lamination impregnated and bonded with special type adhesives, and is especially suitable for the small-quantity production of parts involving difficult and compound curvatures. Flat surfaces of a limited area can be produced but the material is not primarily suited to the manufacture of extensive flat or slightly curved surfaces such as fuselage panels. Advantages of Pytram include the fact that initial tooling costs are low and that the molds can be altered or completely redesigned in a few hours at small expense.

Properties of Pytram are set forth as follows: density, 48 lbs. per cu.ft.; spec. gravity, 0.77; tensile strength, 3,900 lbs. per sq.in.; bolt hole tensile strength, 4,020 lbs. per sq.in.; shear strength, 2,000–3,000 lbs. per sq.in.; temperature range, satisfactory in temperature range from 70° C. to 130° C.; weathering water absorption 1.92 per cent (no apparent deterioration of material); and modulus of rupture bending, 5,960 lbs. per sq.in.

Typical products manufactured from this material are illustrated. They include a gun heater-tube of varying section and contour to negotiate structure of wing; Rolls-Royce Merlin supercharger intake; oil-cooler duct fairing for Bristol Beaufighter; and tail-fairing for Westland Lysander. Material is being developed with a view to its ultimate employment for semistructural parts. *Aircraft Production*, November 1941, pages 20, 21, 4 illus.

The du Pont Rivet—A New Blind Fastener for the Aircraft Industry. L. A. Burrows and D. L. Lewis, Jr. Summary of a paper delivered at the 1941 National Aircraft Production Meeting of the Society of Automotive Engineers. The discussion following its delivery is also reported. An explanatory account is given of the explosive riveting principle developed by the E. I. du Pont de Nemours & Co. *S.A.E. Journal*, December 1941, pages 53, 54.

Sticking It. A new cement is described as a method of securing economy in synthetic adhesives. Its applications for joining fully cured Bakelite materials are outlined. *Flight*, November 6, 1941, page 316, 2 illus.

Synthetic Rubber Development. T. L. Garner. A review of the technical development and possible applications of such synthetic rubber products as have reached the market. The economic aspect of these materials is also noted. *Aircraft Engineering*, August 1941, pages 216, 217, 218.

The Case for Wood. W. R. Chown. A manufacturer of wooden propeller blades discusses reinforced wood as a proper blade material. He cites early objections to this type of material and the manner in which these were successively overcome through the application of improved processes. Comparisons are made to the reputedly desirable features in metal blades. The writer concludes that present wooden blade manufacturing technique produces blades of less weight than in metal propellers and of equal aerodynamic efficiency. *Flight*, November 20, 1941, pages 365–367, 4 illus.

New Type of Blind Rivet. R. H. Gill. Description of the structure and use of the *Rivnut*, a metal fastener, originally made for attaching de-icers to the leading edge of a wing. This device has also indicated itself to be useful as a blind fastener. *Aero Digest*, December 1941, pages 232, 234, 7 illus.

Rubber for Defense. Latest developments in the fields of crude and synthetic rubber, rubber chemicals, and reclaimed rubber are reviewed in a symposium as follows: "Cooperation of the Rubber Industry with Defense," W. L. Finger, OPM; "Present Status of Crude Rubber," E. G. Holt,

U.S. Dept. Commerce; "Present Status of Synthetic Rubber," E. R. Bridgwater, du Pont Co.; and "Present Status of Rubber Chemicals and Reclaimed Rubber," J. P. Coe, U.S. Rubber Co. *Industrial and Engineering Chemistry (Indus. Edition)*, November 1941, pages 1335–1351, 19 illus.

Maintenance

Mass Maintenance Methods. Charles "Chief" Kidder. An account of the maintenance setup in the service shops of Cal-Aero Academy, where 598 men service over 256 airplanes used in training. *Aviation*, December 1941, pages 80, 81, 176, 11 illus.

Servicing Canadian Kinners. The chief engineer of Kinner Motors, Inc., describes the maintenance of the Kinner engines that power the Fleet Finch II primary trainers which are being flown day in and day out under the British Commonwealth Air Training Scheme. *Aviation*, December 1941, pages 75, 194, 4 illus.

Light Plane Maintenance. Donald C. Dobbyn. The chief of the maintenance section of the Civilian Pilot Training Program reviews lessons about light airplane maintenance that have been learned through the C.P.T. program. *Aviation*, December 1941, pages 73, 216, 1 illus.

Men on the Ground at Hamilton Field. The organization of maintenance work at training and tactical fields of the Army Air Forces is described, using the work at Hamilton Field, California, as representative of that done at most of the larger pursuit fields where Base Engineering officers are stationed. *Aviation*, December 1941, pages 64, 65, 6 illus.

Maintenance on the Move. A review of new equipment and methods used by the Air Corps for servicing combat airplanes in the field. *Aviation*, December 1941, pages 62, 63, 166, 9 illus.

The War and Aircraft Maintenance. Reagan C. Stunkel. The head of Lockheed Aircraft Corporation's service organization reviews some of the lessons his firm has learned from the war. *Aviation*, December 1941, pages 58, 59, 204, 5 illus.

Northwest Airlines Wins AVIATION's Maintenance Award. *Aviation* announces its 1941 maintenance award for the airline flying less than 100,000,000 revenue passenger miles per year. The maintenance organization of Northwest Airlines, the winner, is briefly described. *Aviation*, December 1941, pages 52, 53, 10 illus.

Quick Turn-Around. Edward W. McVitty. An account of maintenance methods being used on the North Atlantic service of Pan American Airways, this article is the third and concluding one P.A.A. transoceanic operations. Especially noted is the manner in which each of the airline's shops has had to do its own pioneering and develop its own maintenance technique. *Aviation*, December 1941, pages 50, 51, 178, 180, 10 illus.

British Service Teams Study American Aircraft. An explanation of a plan now in operation to improve the maintenance and servicing of American flying equipment abroad. Service teams of R.A.F. enlisted mechanics are being trained in the assembly, repair and servicing of American equipment at various plants throughout the United States where airframes, engines, instruments and other accessories are in production for the British. The writer urges a lease-lend program for small tools. *Aviation*, December 1941, pages 70, 182, 1 illus.

Medicine

Undertryckskammaren och dess betydelse for luftfartsmedicinen (Low Pressure Chambers and Their Importance to Aviation Medicine). Nils Sundgren. Continuation of the article in the previous number of this magazine wherein the author cites the various investigations of Lottig and Meier-Mueller. *Flyg och Motor (Technical Supplement) Flygning*, October 1941, pages VII–VIII.

Night Vision. Capt. Brain St. J. Steadman. An explanation of methods for adapting the human eye to darkness. Causes of night blindness are given and the value of Vitamin A in reducing it is discussed. The tests used in the training of night aircrews are described. *Flight*, November 20, 1941, pages 358e–358g, 4 illus.

Metallurgy

Magnesium by the Hansgirg Process. S. D. Kirkpatrick. An account of the Hansgirg process as used in the first commercial plant in this country for the production of metallic magnesium by the electrothermic reduction of the oxide. The operation of the process depends basically on the reduction of magnesium oxide to magnesium with finely divided carbon as the reducing agent, effected at 2,000–2,100° C. in an electric resistance furnace.

Sudden cooling of the reaction products, magnesium and carbon monoxide is necessary to prevent reversal of the reaction. In the new plant in California natural gas is used as the cooling medium and is subsequently utilized as fuel in the cement mill that adjoins the magnesium plant. Petroleum coke is used as the reducing agent; magnesia is mixed with petroleum coke and formed into briquets with pitch binder and these briquets are fed continuously to the reduction furnace in which an atmosphere of hydrogen is maintained.

After the products are quenched by a blast of natural gas in a condenser, the magnesium and certain impurities are carried along as a dust to an electrostatic precipitator. The dust collected here is tableted and redistilled in electrically heated retorts operating about 750°C. and under extremely high vacuum; the vaporized matter is deposited on water and oil-cooled steel walls of a removable shell.

Photographs of parts of the plant and estimates of the power consumption for the process are given. *Chemical and Metallurgical Engineering*, September 1941, pages 48, 91–94.

Exposure Chart for Radiography of Steel. Herbert R. Isenburger. A set of exposure charts are presented for use in the radiography of steel. The diagrams are based on the following combination: pulsating direct current tension generating equipment; line focus, grid action X-ray tube; high-speed industrial intensifying screens; blue base safety film; five-minute development at 65°F.; film density 0.7. *Metal Progress*, October 1941.

Lightweight Champion of the Metals. Alden P. Armagnac. The properties of magnesium which adapt it so successfully to the construction of airplanes for the saving of weight are outlined with information on the consumption and uses of the metal. *Popular Science*, December 1941, page 59–62, 15 illus.

The Heat Treatment of Aluminum and Its Alloys. An article treating of the solution heat-treatment practice; precipitation heat-treatment or artificial aging practice; and annealing of heat-treatable alloys. *The Engineer*, August 8, 1941, pages 94–95.

Substitution of Molybdenum for Tungsten. Molybdenum high-speed steels, with or without tungsten, can be substituted for the tungsten high-speed steels rather sweepingly, according to this article. Tables list tungsten high-speed steel and molybdenum substitutions; a number of compositions of low-alloy tool steels containing tungsten, with suggested molybdenum substitutes; and a few compositions of die steels containing tungsten, used mainly in hotworking of metals.

Many exhaust-valve insert seats and exhaust valves for aircraft en-

gines are made from an alloy containing tungsten as follows: 0.45 C, 0.70 Mn max., 0.50 Si, 14.0 Ni, 14.0 Cr, 2.5 W, and 0.35 Mo. Both Wright and Pratt & Whitney are using this steel. A composition is available for insert seats closely corresponding to this, except silicon ranges from 2.75 to 3.25.

Relatively large quantities of the following molybdenum-steel are being sold for use as valve-insert and exhaust-valve steel and as intake-seat steel: 0.70 C, 0.50 Mn, 1.0 Si, 3.0 Cr, and 5.0 Mo. Intake valves for aircraft engines are now made from alloys of the following compositions: (1) 0.55 C, 0.30 Mn, 3–4 Cr, 13.5 W; (2) 0.30 C, 0.50 Mn, 12–13.5 Cr, 2–3 Si, 7–8.5 Ni. It has been said that these two compositions are not to be taken as interchangeable for this application; the Pratt & Whitney engine requires (1) and the Wright (2); but other engineers believe that all intake valves may be made of (2) if necessity arises.

Substitution of molybdenum for tungsten in armor-piercing projectiles and bullet inserts, magnet steels, and electrical equipment is considered. Greater use of cemented carbide tool materials would result in appreciable savings in tungsten. Greater use of tipped tools would save material in tool stock. *Mechanical Engineer*, November 1941, pages 798–800.

Information on Molybdenum High Speed Steels Prepared by OPM. Heat treatment of molbdenum high speed steels; salt bath method for hardening molybdenum high speed steels; and controlled atmosphere furnaces for heat treatment of molybdenum high speed steel are discussed in three papers. *Heat Treating and Forging*, October 1941, pages 519–524, 1 illus.

Effect of Shot Blasting on Strength of Metals. Effects of shot blasting on the tensile properties and fatigue strength of S.A.E. 1045 (annealed, and heat treated), S.A.E. 9260, Armco Iron, and S.A.E. X4340 steels are shown in tables. Endurance curves are drawn for machined specimens, unmachined wire, and unmachined wire showing effect of tempering after shot blasting. Tension test diagrams have also been prepared. *Heat Treating and Forging*, October 1941, pages 516–517, 4 illus.

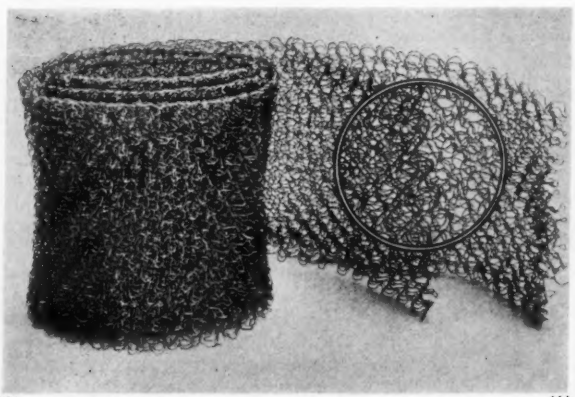
Flow and Rupture of Metals. G. Sachs. Effect of stress state on ductility; stress and strain of single crystals and of polycrystalline aggregates; and strain-hardening of metals are considered. *Heat Treating and Forging*, October 1941, pages 511–515, 8 illus.

Determining the Case Depth of Carburized Work. Description of a simple method, requiring little equipment, for determination of case depth of carburized work. *The Engineer*, August 8, 1941, page 87.

Beryllium Copper in the Aircraft Industry. An alloy for which many uses are predicted in the aircraft industry is beryllium copper. Best known applications so far are found in instrument parts, beryllium copper being nonmagnetic; and in adjustable-pitch propeller hub cones and retractable landing gear parts, where good wear resistance is required. The alloy also has possibilities in the working of magnesium.

Springs made from this alloy have the corrosion resistance of copper plus high resistance to fatigue, high resilience and low hysteresis loss. In addition to coiled springs and flat springs, the list of spring-like parts includes diaphragms, fuse clips, current-carrying contact springs, spring washers, switch blades and similar articles.

The list of applications is constantly being extended and beryllium copper is being substituted for other copper alloys and for steel, even though it is relatively more expensive than the



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older alloys. Beryllium metal has about the same density as magnesium, but greatly exceeds both magnesium and aluminum in its melting temperature, which is 1,285°C. This excess of about 600°C. makes beryllium, for practical purposes, the only stable light metal with a high melting point. Tables show: mechanical properties of 2.15 per cent beryllium-copper 0.050 in. gage sheet, and physical constants of beryllium copper. *Aircraft Engineering*, August 1941, pages 235, 236.

Beryllium. Charles T. Malone. An account of research being done by metallurgists in the effort to alloy beryllium. The significance of the objective to aviation and the potential effect of such a discovery on the industry's future is emphasized. *Flying and Popular Aviation*, December 1941, pages 24, 25, 94, 96, 2 illus.

Military Aviation

Another Letter From England. John W. Morrison. A letter, written to Cy Caldwell on general aviation conditions in England. It discusses first the position of the Fleet Air Arm in England, complimenting it for the work the body has accomplished with its existing aircraft and passing on some criticism for the lack of good dive bombers and faster fighters.

A general discussion of and comparison between American and British aircraft, and the German types they must face, includes such types as the Consolidated Liberator and the Boeing Flying Fortress, the Short Stirling and the Handley-Page Halifax, the Bell Airacobra and the Messerschmitt Me-109F, particular attention being given to the fire power and fuel injection systems. The writer also give opinions on the employment of larger bombs against German objectives. *Aero Digest*, December 1941, pages 50–53, 11 illus.

Blitzkreig and How to Stop It. A. T. Colwell. Calling the blitzkreig technique of warfare much over-publicized, the president of the S.A.E. indicates that the Germans have simply thrown organized mechanization against old weapons and old ideas of warfare, on the basis of revolutionized principles of war due to the development of the internal combustion engine. *S.A.E. Journal*, December 1941, page 56.

Land and Air Power to Combine in Army's Fightin'est Division. Maj. Frank L. Nelson. An analysis of the air and land cooperation program being developed in operational training of the Fourth Division. The division is now serving as an experimental unit for the development of tactics in air reconnaissance, observation of artillery fire, photography, dive-bombing of evening objectives and control of troop movements. *U.S. Air Services*, October 1941, pages 19, 20, 36, 1 illus.

The Army Air Forces as Now Set Up. An explanation of the present organization of the U.S. Army Air Forces and the nature of the changes wrought in the recent reorganization of the Air Corps. *U.S. Air Services*, October 1941, pages 25, 26, 38, 1 illus.

Het Richprobleem in den Luchtoorlog (The Problem of Taking Proper Aim During Aerial Combats). A general review of the difficulties which confront the gunner during aerial combat. As aiming in the air cannot be compared with gunning on the ground, due to the tremendous speeds and maneuverability of the fighting planes, a good method for proper aiming is to observe the smoke or light tracks of the tracer bullets. *Vliegwereld*, October 9, 1941, pages 577–578, 2 illus.

How Good Are America's Warplanes? J. L. H. Peck. This analysis of U.S. fighting aircraft reveals superiority in all factors that count. A table gives figures (some of which are unofficial) indicating top speeds (12,000–25,000 ft.) of five ships of the U.S., Britain, and Germany, in use or in production.

Range, fire-power, speed, rate of climb, and maneuverability are discussed. According to the writer, "balance is achieved through interaction of engineering ingenuity, research, production, and the time in which to put these to work. America has more of all four than any country in the world." *Scientific American*, September 1941, pages 119–123, 2 illus.

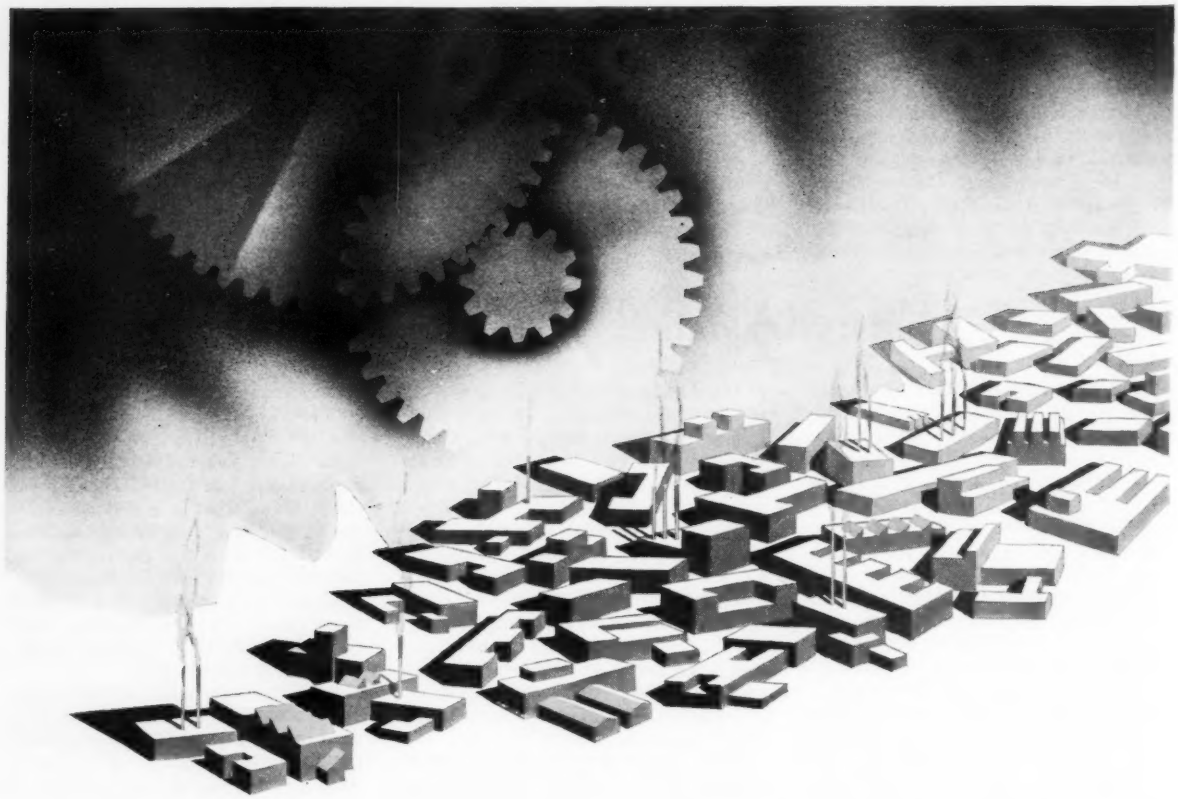
Junior Air Force. J. Montagnes. The Government-sponsored Air Cadets League of Canada, a junior voluntary air force in training, gives technical instruction to Canadian boys 12 to 18. The program includes instruction in flying fundamentals, model airplane building and flying, learning to distinguish British and Axis plane types, how to help at airfields in emergency, airfield operation technique, and maintenance and ground staff work. *Western Flying*, November 1941, pages 61, 112, 113, 4 illus.

Air Corps Learned Plenty on Maneuvers But Did the Ground Troops? Garrett Underhill. A witness of the recent maneuvers renders an analysis of aviation activities during the maneuvers, particularly in the field of light-plane operations. His estimate finds ground-troop cooperation wanting. *Aviation*, December 1941, pages 54–57, 198, 200, 18 illus.

Civil Air Defense Organization. Report on the status of the national plan for civil air defense organization in the United States. The current position of units in various states is noted along with plans for organization in other states. The use of radio and cooperation with aircraft warning service are described. *Dixie Air News*, November 1941, pages 14, 21.

The Fighting Bomber. An interpretation of the tactial strategy underlying the adaptation of the bomber type airplane to service as a fighter type. A description of some of the bombing airplanes so adapted is included. *The Aeroplane*, October 24, 1941, pages 452, 453, 4 illus.

Curtiss P-40 fuselages on the assembly line at the Curtiss-Wright plant, Buffalo, New York.



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Naval Aviation

La Fuerza Aerea y su participacion enel Combate Naval (The Air Force and Its Participation in Naval Warfare). Marcos Vega. The first installment of a review of the effects of aviation on modern naval warfare. The use of bombers and torpedo airplanes, tactical formations, anti-aircraft guns and armored superstructures on men of war are discussed. *Revista de la Fuerza Aerea*, July-August-September 1941, pages 33–41.

The Bomber Challenges the Battleship. Lt. Victor F. Blakeslee. An outline of the potentialities of airplanes, particularly bombers, as a superior means of attacking naval vessels. *Popular Mechanics*, November 1941, pages 17–24, 176, 16 illus.

Parachutes

The Battalions of the Air. A description of the organization and operations of the Parachute Troop Units of the British Army. *The Aeroplane*, October 31, 1941, pages 480, 481, 3 illus.

Paratroop Training. A description of the training of British parachute troops is summed up in observations on the cooperation of Army and Navy units using old tactics but a new form of transport. *Flight*, October 30, 1941, pages 297–300, 11 illus.

Personalities

The McKee Trophy Winner. An outline of the career and major achievements of Thomas W. Siers, winner of the 1940 McKee or Trans-Canadian Trophy which is awarded annually for the most notable contribution to the progress of Canadian aviation. The recipient's contribution which won the award was the development of the oil dilution system of cold weather aircraft starting on the brush records. In the 14 years of the trophy's history, this is the first selection of a maintenance man as winner. *Canadian Aviation*, October 1941, pages 31, 32, 40, 6 illus.

Personairlities. Cy Caldwell. An intimate biography of Lieut. Col. Arthur I. Ennis, Chief of the Army Air Forces Public Relations Bureau. *Aero Digest*, December 1941, page 87, 2 illus.

Who's Who in Production. Brief pen pictures of leading personalities in the manufacture of British aircraft, including: Lt. Col. J. T. C. Moore-Brabazon; Air Chief Marshal Sir W. R. Freeman; Sir Charles Bruce-Gardner; J. C. Buchanan; A. F. Sidegreaves; and Sir F. S. Spriggs. *Aircraft Production*, November 1941, pages 11, 12, 6 illus.

Photography

Photographic Exposure Tables. An exposure table standard has been prepared to satisfy the demand for accurate and authoritative exposure tables. By their use the exposure necessary for satisfactory reproduction of any scene at any time of the day as well as in any part of the world from the equator to lat. 65° may be calculated, provided manufacturer's speed number for film or plate in use is known. *Aircraft Engineering*, August 1941, page 236.

Plastics

Structural Plastics in Aviation. J. B. Johnson. The aviation industry's interest in plastics—particularly those products in which the synthetic organic resins are used in sufficient quantity to influence the specific gravity and mechanical characteristics, is set forth. Use of clear plastics, manufactured without use of opaque fillers, in secondary structures, such as cockpit and instrument enclosures, nose sections, etc., is established.

The resin-filler combinations offer greater opportunity for high mechanical properties. To date the highest properties have been achieved with phenol-formaldehyde-wood compositions, and indications are that the mechanical properties will be satisfactory for seats, wheels, and structural members of the airframe. Such parts can be designed relatively free from sharp bends and compound curves. Combinations of impregnated outer plies and natural veneer inner plies may alleviate the weight of some of the metals now employed in aircraft construction.

Fabrics, paper, and numerous textile fibers, both natural and synthetic, have received intensive study for fillers since they produce mixtures which are easily molded. Laminated fabrics should have equal strength in the warp and filling. Fibers must be arranged in alternate layers at right angles to each other, and any molecular orientation of synthetic fibers must be balanced.

Economic production of plastics is a factor in selection of a material. Plastics which can be molded or formed in dies of low cost will have the advantage. Standards issued by the American Society for Testing Materials which were developed in cooperation with the plastics industry, form the basis for test procedure adopted by the Air Corps. Results of these tests are shown in a table and graphs. The writer contends that "the aim (of plastics industry) should be to take full advantage of the wide range and versatile characteristics of the synthetic material to create a better airplane and not simply to obtain substitute materials for the present emergency.

"In the utilization of plastics, the industry can expect the airplane builder to furnish the engineering, but in return, the plastics industry must be able to supply data on engineering properties of its products." *Modern Plastics*, November 1941, pages 179–181, 210, 212, 214, 10 illus.

Transparent Enclosures for Aircraft. Production of molded Perspex panels and bullet-resisting laminated glass for installation in British warplanes is described in detail. With specific gravity of 1.19, as compared with 1.35 for safety celluloids and upwards of 2.5 for glass, Perspex has what is claimed to be the lightest weight of any of the transparent materials in common use. *Aircraft Production*, November 1941, pages 4–8, 13 illus.

Plastics Applied to Airplane Structures. C. F. Marschner. The application of plastics to the basic structure and other portions of the airplane which are now fabricated from sheet metal is considered. The future of plastics in airplane manufacture and especially their application to structural components depends almost entirely upon the amount of research and development effort expended to affect their usability and the ingenuity applied both in designing for and manufacturing with these materials.

On the basis of technical considerations alone, which are not discussed in detail by the writer, plastic can and likely will permit structural simplicity which will reflect itself in weight savings and reduced cost. There is good reason to believe that tooling up for molding will ultimately prove faster and less expensive than tooling up for sheet-metal fabrication. *Mechanical Engineering*, November 1941, pages 787–790.

Plastic Digest. Review of the more important articles dealing with plastics which have appeared in recent publication. *Modern Plastics*, November 1941, page 192.

Plants

Insulating "Blackout" Plants. H. T. Rutledge. Windowless bomber factories will contain more glass than "daylight" structures, according to this writer who notes the structural materials and features being applied to the design of the new blackout plants built for America's expanding essential industries. *Scientific American*, December 1941, pages 328, 329, 3 illus.

Airplane Plant Built of Timber. An account of the design and construction of a Canadian Aircraft plant in the building of which local materials were used to conserve steel. The structure is sheathed in plywood and framed in timber. It is 260 × 780 ft. and will be used for the manufacture of flying boats by the Boeing Aircraft Company of Canada, Ltd. *Engineering News Record*, October 9, 1941, pages 64–66, 4 illus.

Blackout in Factories. Two methods of obscuring glass roofs during darkness while retaining the benefit of daylight are described—one a simple German method for large skylights, and the other an electrically operated system in a British factory. *Aircraft Engineering*, August 1941, pages 225, 226, 6 illus.

Production

Tapping a Production Reservoir. Maj. V. E. Bertrandias. Douglas Aircraft Co. was the first major airplane manufacturer to put to use the automobile industry's production capacity in building subassemblies for military aircraft. Full production of wing sections, tail groups, engine nacelles and other major units for Douglas bombers and military transports is in force at Murray Corporation of America, Briggs Manufacturing Co., Pullman-Standard Car Mfg. Co., McDonnell Aircraft Corp., and Fleetwings, Inc. Adaptation of technique perfected by each of these companies to the production of airplane parts is described. *Western Flying*, November 1941, pages 38, 39, 54, 8 illus.

Templates by X-Ray. North American's new X-ray photo-template unit is designed to reproduce layouts up to 4 × 8 ft. Larger layouts are done in sections and later spliced together. One-half hour is minimum time necessary to make a minimum size print. Various steps of new method which eliminates checking of duplicates, are described and illustrated. *Western Flying*, November 1941, pages 45, 46, 5 illus.

Plaster Patterns. H. Plunknett. In addition to supplanting the normal wooden type for jigs or component castings, plaster patterns may also be used for casting zinc and zinc-alloy dies for drophammer work, and can be made directly from a finished part. This possibility, reviewed in this paper, is of particular value in making a tool to reproduce a mock-up curvature or a panel from a protrotype machine. There appears to be no critical limit to size of patterns which may be made in plaster, and units ranging from 2 in. sq. to 10 or 12 ft. sq. have been made with success. Discussion covers: preparing plaster; hollow patterns; clay-cored patterns; and sectional patterns. *Aircraft Production*, November 1941, pages 13–16, 12 illus.

Doctor X-peditor. H. Mansfield. Nearly 200 "troubleshooters" at Boeing's Seattle plant link operations of the various shops and coordinate efforts of the drafting room with the production of the actual aircraft. Complete knowledge of stock, of shop procedure, and ability to act as "buffer" are qualifications. *Western Flying*, November 1941, pages 43–45, 8 illus.

"Teamwork for Production." Robert Monroe. The director of purchasing in an American aircraft plant writes on the simplified organization and the breakdown of component parts. And the breakdown of component parts which have been so effective in speeding up airplane production in this country. The flow of materials and parts from subcontractor to the delivery line is traced. *Aviation*, December 1941, pages 86, 87, 96, 10 illus.

Illustrated Production Breakdown. Summary of a paper delivered by George Tharratt. The gist of this method of production illustration is said to be the replacement of all blueprints on the final assembly line with perspective drawings showing the assembly as it should look when completed. Chief problem is said to be the securing of engineers who have talent for such illustrating. *S.A.E. Journal*, December 1941, pages 55, 56.

Morale—An Account of Our Production Position. Summary of a paper delivered by T. P. Wright at the 1941 National Aircraft Production Meeting of the Society of Automotive Engineers. The discussion following its delivery is also reported. The chief consultant to the O.P.M. on aircraft production problems, reviews current progress in this phase of the American war effort. *S.A.E. Journal*, December 1941, pages 56, 57.

Engineering Liaison and Production Control. Donald U. Kudlich. In this paper, it is suggested that there are but two possible solutions to the problem of engineering liaison production control—either to eliminate the gulf between production and engineering people by training them to think and act as one, or to bridge the gulf between them by establishing special liaison through a small number of specialists. The latter is viewed as the only practical one since engineering and production personnel are widely separated by training, experience and general attitude. The manner in which the problem is solved at Wright Aeronautical Corporation is described with details on organization and procedure. *S.A.E. Journal*, December 1941, page 18.

Off the Ground—Into the Air. H. H. Budds, F. W. Hofmann, E. E. Lundberg, H. T. Platz, and H. J. Roesch. This joint paper admits that mass production methods are not directly applicable to most aircraft manufacturing work. Considerable stress is laid on the development of efficient assembly jigs and on the training of personnel. Specific training is suggested in employee attitude, in an effort to instill workers with a feeling of importance in the whole production scheme so that they may take more pride in the operation they each perform. *S.A.E. Journal*, December 1941, page 53.

Spitfires in the Making. A camera-visit to one of the numerous English plants engaged in the assembly of Spitfire Mark II fighters. The article indicates considerable use of women and other types of semiskilled and unskilled labor. *Aeronautics*, August 1941, pages 46, 47, 7 illus.

New Fabric-Attachment Method. Courtney Randall. The method for attaching fabric at Bell Aircraft Corporation Plant is described as unique but simple. The new fabric attachment equipment includes a special rib—a thin retainer strip and a hand tool for pressing it into the rib which is an extrusion of 24ST aluminum alloy. Retainer strip is of 2SO aluminum. Corners are clipped and burrs removed. The hand tool is employed to insert the strip in the channel and hold the fabric firmly in position throughout the operation. Details of the method are given. *Flying and Popular Aviation*, December 1941, pages 35, 36, 3 illus.

Machining of Aluminium Alloys. Characteristics of aluminum and aluminum alloys, grouping of alloys with regard to machining properties, cutting materials, and cutting tools are considered. Tables show turning tool angles, and ranges of speed at which various cutting operations may be carried out. *Aircraft Engineering*, September 1941, pages 261–264, 10 illus.

Tooling for the B-26 at Malton. Eric Crawford. Brief description of the tooling up at the Malton plant of National Steel Car Corporation in

Canada for the production of the Martin B-26 bomber. Major time-saving features devised on the original Martin production line have been adopted and certain adaptations have been made to the facilities at the Malton plant. To the greatest possible extent, the tooling is designed to produce complete sub-assemblies which are self-contained and ready to be bolted into the final assembly. Some details are given. *Canadian Aviation*, October 1941, pages 47, 48, 74, 8 illus.

What's the Score in Plane Production? Ralph P. Bell. The director-general of United States' aircraft production reviews achievements of this phase of the National Defense program and explains some of the obstacles, including those yet to be overcome. *Canadian Aviation*, October 1941, pages 24, 76, 1 illus.

Precision Machining Operations on the Cyclone 14 Crankshaft. J. F. McCarthy. A step-by-step explanation of the procedure adopted by Ohio Crankshafts, Inc., in the precision machining of crankshafts for the Wright Cyclone 14 engine, a process which takes 607 distinct machining and inspection operations. *Aero Digest*, December 1941, pages 198, 201, 202, 228, 11 illus.

The Honing Process in National Defense. A. M. Johnson. An explanation of how adaptation of the honing process to airplane manufacture brought about greater precision and increased speed in production of engine parts, propeller hubs, and shock cylinders. Four types of honing apparatus are illustrated. *Mechanical Engineering*, November 1941, pages 811–813, 4 illus.

Northrup Tools Up for Mass Production of Vultee Dive-Bombers. A review of the progress that has been made by Northrop Aircraft, Inc., in tooling up their plant for the production of Vultee Vengeance dive-bombers. This conversion required the creation of between 4,000 and 6,000 templates, and the building of new jigs and dies, as well as the construction of special tools. This work is described along with the quick-quench heat treating furnace which was designed by Northrop's engineers for the company's particular needs. *Aero Digest*, December 1941, pages 205, 206, 209, 22 illus.

The "Edgwick" Cold-Chamber Die-Casting Machine. Cold-chamber die-casting machine for aluminum, brass and magnesium parts, is electro-hydraulically operated, of British manufacture, and in its standard form will inject into the die approximately 1.25 lbs. of aluminum. It can be readily modified to deal with heavier or lighter castings. Standard plunger is 1-$^{9}/_{16}$ in. in diameter.

One important advantage of this method of die-casting is elimination of risk arising from the fact that certain metals, such as aluminum, have a tendency to pick up some of the cast iron of which the melting pot and heated gooseneck forming feed passage in self-contained machine are made. *The Engineer*, August 15, 1941, page 103, 2 illus.

Propellers

The Propeller. How Many Blades? F. W. Lanchester. An exposition of one of the problems in propeller design, namely that of determining the number of blades that can be employed advantageously. This approach is based on an intuitive understanding of the physical phenomenon of propeller operation rather than on a rigorous mathematical approach. *The Journal of the Royal Aeronautical Society*, August 1941, pages 267–274, 3 illus.

At Brewster Aeronautical Corporation's plant in Newark, the Lockheed plant in California, and at other plants throughout the nation, midgets and other small workers are used for tasks in "tight places" which would be inaccessible to the normal-sized mechanic.

Facilitating Production by Tooling Engineering. C. H. Speck. The writer, a methods engineer for Cessna Aircraft Corporation, indicates than many of the production delays which have slowed down aircraft deliveries are accountable by the fact that a large part of the industry, in taking over automobile production methods, began production before tooling was started.

An outline of a method for correcting this is offered through a proper system of tool engineering, planning, design, manufacture, inspection and control, to the end that proper production planning will achieve more efficient and profitable production. *Aero Digest*, December 1941, pages 140, 144, 222, 9 illus.

North American's Extensive Sub-Contracting Program. A study of the operation and growth of the sub-contracting system which now produces 30 per cent of the parts and sub-assemblies for North American Aviation's three plants. *Aero Digest*, December 1941, pages 168, 177, 178, 180, 182, 196, 19 illus.

Vibration Characteristics of Three and Four-Blade Propellers for High-Output Engines. Ralph M. Guerke. Examining the vibration characteristics of this type of propeller, this article discusses the problems inherent in its development. Although the problems involved in developing a satisfactory engine-propeller airplane installation using propellers of four or more blades are admittedly more difficult than those encountered with a three-blade propeller, the writer points out that a satisfactory installation can be made "if the airplane designer will assume the responsibility of reducing propeller interference effects."

This, of course, may be very difficult if not impossible, to accomplish in "pusher" installations according to the writer. Reporting that two such installations have been made in a normal tractor four-blade installation without recourse to odd blade spacing, he contends that successful installations

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also can be accomplished in propellers of five or more blades under similar conditions.

Dual-rotation propellers, it is said, will introduce additional propeller design problems of a vibration nature which may require certain compromises in diameter, blade construction, and engine gear ratios before satisfactory installations can be made. It is suggested, however, that these compromises can be made without sacrificing airplane performance.

The technical discussion that precedes these conclusions takes up engine excitation; aerodynamic excitation, aerodynamically excited three-blade propeller vibration, aerodynamically excited four-blade propeller vibration, methods of reducing or avoiding aerodynamically excited stress, dual rotation, and effects of propeller isolation on aerodynamically excited stress. *S.A.E. Journal*, December 1941, pages 544–552, 25 illus.

The Contra-Rotation Propeller. A new propeller combination (oppositely rotating constant-speed, three-bladed propellers, capable of being driven by a single engine) has the advantage of reducing disk diameter "and there is less tendency for designers to yield to the temptation of raising tip speed to a level so close to velocity of sound as to lower the efficiency of the propeller.

"On balance the slight extra weight involved by use of the contra-rotating propeller may well prove to be a price worth paying. In this connection it is worth recalling the experiments of General Rota on contra-rotating ship propellers and particularly his discovery that there was a marked improvement in propeller efficiency when the propellers were of different diameters." *The Engineer*, September 5, 1941, page 150.

The Lorraine-Koolhoven Contraprop. "Sterna." A review of the work done by Fritz Koolhoven and the Lorraine Dietrich company on the contra-rotating propellers designed for the Koolhoven Fk. 55 single-seat fighter. The solution of the problems of designing and constructing efficient gearing to run the two propellers is explained. It is said that only the chaotic state of the French industry prevented complete success in the project. *The Aeroplane*, October 17, 1941, page 432, 3 illus.

Engine - Airscrew Vibrations. Charles M. Kearns. The problem of engine-propeller vibration is reviewed in the light of current practice. Certain observations made in the course of experimental study of the complete problem are discussed in detail.

The non-reproducibility of supposedly identical engine-propeller systems has led to an intensive study of several possible types of variables; clearances between vibrating members have so far been found to be of the utmost importance. *Aircraft Engineering*, August 1941, pages 211–215, 10 illus.

The Balancing of Airscrews. H. Castaing. A description of the procedures and machines employed by the Hispano Suiza firm in the balancing of propellers. *Aircraft Engineering*, March 1941, pages 61–65, 22 illus.

Radio

Radioed Maps in Code. A picture explanation of the strategic use of the Finch telecommunication system for the radio transmission of coded military information from the airplane in flight to decoders at headquarters. *Air Trails*, October 1941, page 17, 5 illus.

Radiorange Ambiguities. David S. Little. The writer compares the problems of radio range flying with driving a car in foggy weather, indicating that as on the road, familiarity with the peculiarities of a particular radio range makes for increased ease of operation. While the studies of radio range flying made in the Link trainer study, for the most part, theoretically perfect range conditions, actual flying conditions contain such imperfections as multiple or false cones, split on-course conditions, bends in the range, etc. This article interprets these imperfections, explaining them in terms of local conditions around LaGuardia Airport in New York. *Aero Digest*, December 1941, pages 62, 65, 222, 1 illus.

Standardization

Aspects of Practical Standardization. B. C. Boulton. A survey of the efforts made by the aviation industry to achieve some kind of standardization, centralizing their work through the Society of Automotive Engineers and the National Aircraft Standards Committee. Such phases of the problem are discussed as the fields and sources of standards for aircraft, the parts that are susceptible to standardization, and the general benefits to be derived from wider standardization.

Precautions are urged against some of the dangers of premature and untried developments in this field. Standards should be finalized it is said, only after they have been tried thoroughly in the production shop. Suggestions are made for procedures in putting standards into effect in the industry. *Aero Digest*, December 1941, pages 217–222, 4 illus.

Methods of Ensuring Interchangeability. B. Kaiser. Difficulties encountered when dealing with interchangeability of large aircraft, which have been extensively subcontracted, are considered at length and the main points requiring consideration are summarized as follows:

(1) Drawing limits should be standardized in order to reduce production costs and simplify supply and maintenance of shop gages. (2) Standardization of parts should be carried out on a wider scale under some coordinating authority. (3) Subcontractors should be allowed to specialize on one component only and not devote their energies to producing as many components for as many aircraft as possible, with consequent disorganization of stores and production systems. (4) Improved equipment for setting large assembly jigs is required. (5) Detail interchangeability must be planned at the commencement of the design, by master drawings and standard parts. To this end drawing alterations must be kept to minimum. (6) Parent firms should create a special department to deal with interchangeability problems. (7) Toolmaking facilities should be extended to cope with the increased requirements of production. *Aircraft Production*, November 1941, pages 53–61, 20 illus.

Standards for Defense. C. E. Stryker. Standards are said to come under two major classifications, production and development. Two forms of tangible results are developing from present standards work. An increased number of Government standards are being issued, and many industrial standards are being established, representing agreements between or among competing industrial organizations. *S.A.E. Journal*, December 1941, pages 54, 55.

New Aircraft-Engine Drafting Manual Standardizes Drawing Room Practices. Final version of the S.A.E. Aircraft-Engine Room Practice manual, just off the press, was prepared by Subcommittee E-8 of the Aircraft-Engine Subdivision, Aeronautics Division, S.A.E. Standards Committee.

Rapid expansion of the aircraft industry made imperative development of a standardized procedure for preparation of aircraft-engine mechanical drawings. New manual is designed to establish a common drafting room "language" so that signs and symbols appearing on aircraft engine blueprints may be uniformly interpreted by manufacturers, subcontractors and vendors.

In compiling present edition, the committee consulted all available manuals, both published and unpublished, prepared by the Air Corps and various engine manufacturers to suit individual needs. Contents of the

manual include data on preparation of a mechanical drawing, such as arrangement of views, lines and line work, sectional views, dimensioning, screw thread representation for threaded parts, lettering, and drawing sheet sizes and arrangement. Dimensioning by the decimal system is a new method described. Typical pages from the draftsman's manual in illustration. *S.A.E. Journal*, December 1941, page 41, 1 illus.

Stress Analysis

Stress Analysis of Aircraft Frameworks. N. J. Hoff. It is shown that the calculation of the critical loads of a plane framework is superfluous if the bending movements in the bars due to external movements and to lateral loads are determined by the Hardy Cross moment distribution method as extended by James. Convergence of this method is a proof of the stability of the framework. In the article the writer discusses methods of determining stresses and critical loads in the framework and deals with the distortion patterns of beam columns on several supports below and above the critical loads. The method is proof of the convergence outlined and regular and particular cases are discussed and proved with the aid of numerical examples. *The Journal of the Royal Aeronautical Society*, July 1941, pages 241–261, 14 illus.

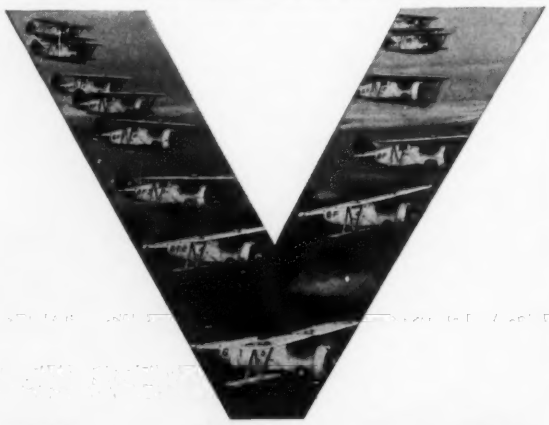
Three-Dimensional Flutter Analysis. William M. Bleakney. The stability equation for a structure acted upon by air forces is set up in a form convenient for flutter analysis. Unrestricted generalized coordinates in complex form are used. Useful expressions are given for the aerodynamical coefficients of airfoils in terms of theoretical two-dimensional coefficients. The mechanical coefficients for airfoils are expressed in terms of quantities generally known or easily calculable.

The value of empirical data from resonance and static-deflection tests is emphasized. The paper is intended as a basis for further development. Detailed steps involved in typical applications will be discussed in a subsequent paper. *Journal of the Aeronautical Sciences*, December 1941, pages 56–63.

On the Reaction of an Elastic Wing to Vertical Gusts. William R. Sears and Brian O. Sparks. Probing the behavior of an elastic wing during and subsequent to its entrance into a vertical gust, investigations have often shown that wing deflections (and therefore stresses) considerably greater than those corresponding to steady-state values are produced by certain combinations of gust gradient and wing elastic properties. This paper is a step in an attempt to determine whether this conclusion may be due in part to the neglect of non-stationary effects.

It is concluded from the results presented that inclusion of all of the non-stationary aerodynamic effects in the calculations leads to relatively low rates of wing deflection and maximum deflections only slightly greater than the asymptotic values. The large deflections calculated in certain cases by other approximate theories do not appear in the particular cases considered.

These conclusions are strictly applicable only to the cases of infinite torsional rigidity considered here. In application to actual airplane wings entering gusts the calculations should be extended to account for torsional flexibility. The wing deflection will then depend intimately on the relative rigidities in bending and torsion and on the location of the elastic and inertial axes. The results presented here can be expected to indicate the behavior of wings that are relatively very stiff in torsion. *Journal of the Aeronautical Sciences*, December 1941, pages 64–67, 2 illus.



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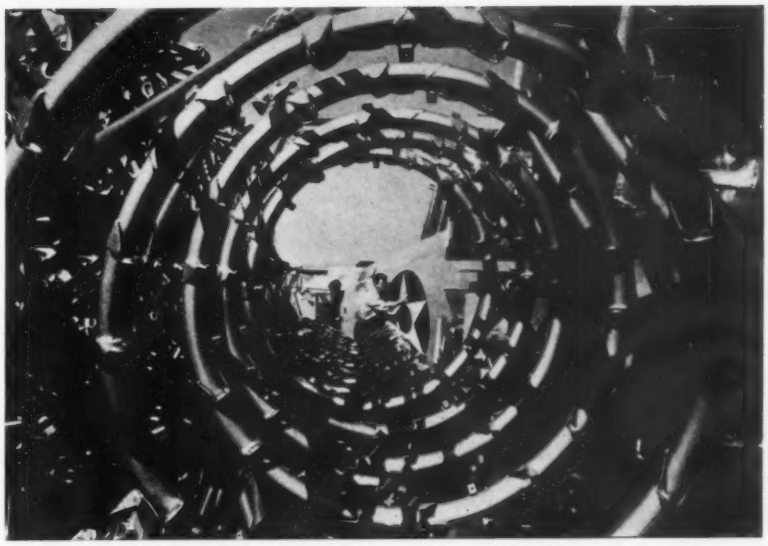
Determination of Strain Distribution by the Photo-Grid Process. Given A. Brewer and Robert B. Glassco. The purpose of this paper is to describe the photo-grid process, a new method of measuring local deformations. The process consists of photographing a pattern of lines upon a sensitized specimen which is then tested and the amount of deformation determined by measuring the new spacing of the lines. Gage lengths as small as 0.01 in. are used. By this process the strain distribution in tensile specimens of aluminum alloys has been plotted; also the strains produced by several forming operations have been determined.

The maximum local elongation measured in tensile test specimens is much higher than the average in two inches and is indicative of the elongations obtained in forming operations of simple bending or stretching. In deep drawn shells even higher strains were measured. The phenomenon of progressive strain hardening with reference to the strain distribution found in the tensile test specimens is discussed. *Journal of the Aeronautical Sciences*, November 1941, pages 1–7, 9 illus.

Structures Unit Assures Integrity of Design. R. L. Schleicher. A description of the work and operations methods of the structures unit of North American Aviation, Inc. This group, charged with the task of guaranteeing the structural integrity of the aircraft, checks for strength of the materials and parts which comprise the airplane, and conducts static tests on elements, parts and completed structures. *Aero Digest*, December 1941, page 192, 1 illus.

Airplane Vibration Tests as Related to the Flutter Problem. Charles B. Lyman. Reviewing the flutter problem in general, this paper proceeds to discuss wing flutter and tail flutter mode natural frequency determination. Also treated is the determination of elastic mass and damping characteristics. *Journal of the Aeronautical Sciences*, November 1941, pages 24–30.

Lateral Buckling of I-Section Column With Eccentric End Loads in Plane of the Web. Bruce Johnston. When a relatively slender column of the symmetrical I or WF shape is loaded eccentrically in the plane of the web by longitudinal end loads it may fail by elastic instability involving a combination of lateral bending and twisting. Timoshenko has shown that in the case of the solid rectangle a considerable end eccentricity causes the critical buckling load to be only slightly less than the Euler critical load for the same strip loaded axially. The corresponding solution for the WF or I-column, presented herein, shows that relatively small eccentricities of the longitudinal end load applied in the plane of the web cause a large falling off from the Euler critical load.



Steel tube engine mounts, ready for installation, at North American Aviation's plant, Inglewood, California.

For the ideally straight column, with a material perfectly elastic up to the yield point, there would be a critical l/r ratio for any given eccentricity, column length, and material. Below this critical ratio the column would fail by yielding, according to the secant or eccentricity formula. Above the critical ratio the failure would be by elastic instability with respect to lateral bending and twisting.

Application of the equations is made to two structural wide-flange sections, of light and medium weight, and the results are presented in the form of diagrams. *Journal of Applied Mechanics*, December 1941, pages 176–180, 4 illus.

Solution of Problems of Elasticity by the Framework Method. A. Hrennikoff. A method is presented for using the framework procedure to solve problems of elasticity without the mathematical difficulties which make the solution of the differential equations of the theory of elasticity impossible in many cases. The method may with some qualifications be applied to problems of two-dimensional stress, bending of plates, bending of cylindrical shells, the general case of three-dimensional stress, and a great variety of others.

Essentially, the method consists in replacing the continuous material of the elastic body being studied by a framework of bars arranged according to a definite pattern, the elements of which are endowed with elastic properties suitable to the type of problem. This framework is then analyzed, according to the procedure outlined in the paper for various types of elastic problems. Examples of the application of the principles involved are also given. *Journal of Applied Mechanics*, December 1941, pages 169–175, 18 illus.

Buckling Strength of Duralumin Columns. According to this article uses of high-tensile aluminum alloy compression members in aircraft construction may be divided into two main classes: (1) that in which the members are employed as stiffeners in stressed-skin construction; and (2) that in which they are employed as struts in trussed structures. In both cases it is necessary to possess a knowledge of the behavior of the alloy concerned when employed in the form of a column.

The paper is devoted to a study of characteristics of single struts. A simple, graphical method is described whereby the behavior of a long column may be predicted, with sufficient accuracy for design purposes, provided that reliable stress/strain data are available from tests conducted on short specimens of the material.

Illustrations show a curve obtained by plotting results of compressive tests on miscellaneous short specimens of Duralumin; the average stress-strain curve for short specimens of Duralumin; the average stress-modulus curve for Duralumin; and the relationship between ultimate strength and slenderness ratio for long specimens of Duralumin. *Aircraft Engineering*, October 1941, pages 281–283, 6 illus.

Solution of Simultaneous Equations. F. J. Turton. A solution is offered for simultaneous equations resulting from successive applications of the theorem of three moments to continuous beams. *The Journal of the Royal Aeronautical Society*, August 1941, pages 275–277, 2 illus.

Buckling of a Strut Under a Compression Which Varies Discontinuously. Jean Drymael. It often happens that in a plane truss all joints are not transversely stiffened. If one joint of the compressed girder of a beam is free, the girder is liable to fail by buckling perpendicular to the plane of the truss, between the adjacent joints. The chart given here enables a rapid determination of the critical loading to be made. The compression and moment of inertia are assumed constant along the length of each bay, but may be different in the two bays. *The Journal of the Royal Aeronautical Society*, August 1941, pages 278–280, 2 illus.

Tools and Equipment

Modern Machine Tools. Latest additions to the range of factory plant are described in this article which presents an Empco 60-in. stroke horizontal honing machine; Milnes general-purpose vertical milling machine; recently introduced Edgwick No. 2 vertical milling machine; Model VI Pallas vertical milling machine; special-purpose Ormerod shaper for machining internal radii; and No. 7 Bardons and Oliver universal turret lathe fitted with single-lever speed preselector, all of which are illustrated and their functions outlined. *Aircraft Production*, November 1941, pages 22–25, 6 illus.

Shop Equipment and Small Tools. Some recently developed small-tool aids to efficient production are presented with descriptions of their design and operation. *Aircraft Production*, November 1941, pages 47–49, 8 illus.

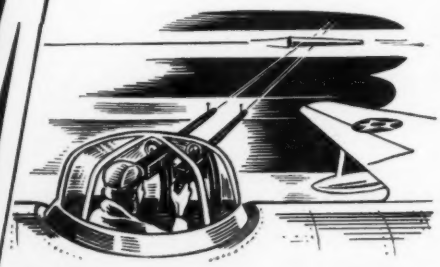
Testing Equipment

Electro-Chemical Analysis Apparatus. A gravimetric electro-chemical analysis is described as capable of determining the composition of a wide range of metals and alloys. The apparatus may be used to remove qualitatively from a solution metals having a colored or otherwise interfering ion which hinders a subsequent operation. *The Engineer*, September 19, 1941, pages 190, 191, 2 illus.

Continuous - Reading Electronic Voltmeter. C. J. Penther, F. B. Rolfson, and L. Lykken. A full-range, sensitive, low-current-drain, continuous-reading electronic voltmeter is described. The meter has a range of 2.11 volts and a sensitivity of 0.001 volt over the entire range. It has been designed for the accurate determination of potentials of electrode systems that have a resistance of 5,000 megohms or less. *Industrial and Engineering Chemistry (Analytical Edition)*, November 1941, pages 831–834, 3 illus.

A New Lateral Extensometer. A. V. De Forest and A. R. Anderson. This paper describes a new lateral-strain gage which utilizes the principle of change of electrical resistance in wires with strain. An application of the instrument to the field of photoelasticity is given in which the problem of determining the individual principal stresses in a model can be solved directly when the information given by the isochromatic pattern is combined with the sum of the principal stresses at the points in question, as determined by the new gage. *Journal of Applied Mechanics*, December 1941, pages 152–154, 6 illus.

A Private Research Laboratory. The testing equipment in the laboratories of the Fairey Aviation Company is described, and explanations are



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given of various testing procedures used. The setup provides for metallurgical and chemical as well as mechanical analyses and tests of airplane models, components, accessories, and materials. *Flight*, November 13, 1941, pages 338b–338f, 11 illus.

Gauging Serrated Shafts. The Clement serration gage comparator, a new British device for checking pitch diameters and chordal spacing of spline shafts and gears is described. It consists of a metal frame carrying a dial indicator graduated in 0.0001 in. On the outer end a hardened and ground pin rests in one of the serrations. At the other end of the frame is a steel ball which may be withdrawn by pressure on an adjacent spring-loaded finger. To place or remove comparator on the work it is only necessary to apply pressure to the finger. To avoid errors due to heat from operator's hand, an insulating gripping disk is provided near outer end. *Aircraft Production*, November 1941, pages 45, 46, 4 illus.

Training

Canadian Aviation's Aircraft Production Training Course. No. 4. A Broad Survey of Bench Work. This installment of the series reviews the range of bench work, factors governing size of tools and the essential operations that can be formed in this phase of production. *Canadian Aviation*, October 1941, pages 53, 54, 56, 74, 2 illus.

Preparation for Airline Pilot Training. Warren J. White. During normal times, most airlines gather a large proportion of their First Officer replacements from the Army and Navy air forces. Now that National Defense has not only increased the operational pressure but has also cut off the main source of pilot supply, the airlines must, in a large measure, train their own men.

This article, written by an American Airlines pilot-instructor outlines the basis upon which the selection of commercially-trained pilots as First Officers is made. Suggestions are also given as to the special studies that a pilot should take before applying, and the books and pamphlets he should absorb before presenting himself to the airline flight director for an interview. *Aero Digest*, December 1941, pages 54, 55, 281, 6 illus.

Certification of Army and Navy Welders. W. R. Allen. An outline of the general examination given for certification as Army and Navy welders of various grades. It contains descriptions of the various test welds which the candidate must submit for the various grades, and the test to which the completed welds are put to determine their conformance to specifications. *Aero Digest*, December 1941, pages 164, 166, 3 illus.

The R.A.F. in the U.S.A. Donn Hale Munson. An account of the training of R.A.F. student pilots are being given in the United States. *Flying and Popular Aviation*, December 1941, pages 48–50, 76, 78, 80, 7 illus.

Lapsed License. Lewin B. Barringer. Warning pilots not to get behind in their flying, a veteran pilot describes his own experiences in taking a refresher course at the CPTP school. *Flying and Popular Aviation*, December 1941, pages 37, 88, 90, 1 illus.

Warfare

Il Dominio Dell' Aira (Mastery of the Air). H. J. A. Wilson. A study of General Giulio Douhet theory of air warfare and its application and justification in the light of military events. An outline of Douhet's military career is also included. *Aeronautics*, August 1941, pages 43–45.

Airmen of Free France. Henry Baerlein. An account of the evolution of the Free French Air Forces and their recovery from initial difficulties is given in this article describing the re-equipped and reorganized unit operating under de Gaulle in cooperation and combat in the Middle East. *Flight*, November 20, 1941, pages 358b–358d, 7 illus.

Air and Sea. Editorial comment on the respective fighting powers of ships and airplanes. The Cretan experience throws light on the relationship of air attack to the defensive power of the lesser ships, the cruisers and destroyers, of which England lost several. "The supreme importance to the Navy of the Air Arm is one of the greatest lessons so far taught to us by the War." *The Engineer*, July 18, 1941, pages 40, 41.

Air Power and Coast Defense. Lieut. Col. T. R. Phillips. Discussing air power as an agent of coast defense, the writer says that possibly naval protection against aerial bombing is at its lowest point at the present time. Most naval vessels now in commission were built at a time when aerial bombing was not a serious threat. Naval protection may improve so greatly that bombing will not remain a serious threat, at least against battleships. However, even if this takes place, the present relationship between air power and sea power will not be changed.

He concludes that "Air power has not superseded coast defenses, but it can perform some of their functions more effectively than guns ever did... Increase in naval air installations on the shore, together with acceptance of bombardment of nonmilitary installations as legitimate targets, makes more harbor defenses necessary for their protection. Any harbor defenses constructed or modernized should take into account the ability of the bombing plane to perform certain of the old missions." *Army Ordnance*, September-October, 1941, pages 217–220, 1 illus.

War Moves to the Stratosphere. James L. H. Peck. An account of the hazards of high altitude flying, accompanied by descriptive information on the devices and equipment employed in protecting military airplane crews in the stratosphere. *Popular Science*, November 1941, pages 102–109, 220, 222, 224, 22 illus.

Welding

A Procedure Control for Aircraft Welding. A. K. Seemann. Conclusion of a discussion on procedure control in the welding of aircraft. Essential elements of such control were discussed in part I. The current installment treats of details of the welding operation with specific discussion of various techniques. Also presented are the qualifications required of the welding operator, to follow the procedure, inspection of completed work, jigs and fixtures, and important precautions for operators. *Aviation*, December 1941, pages 116, 117, 210, 8 illus.

Atomic Hydrogen Welding in Aircraft Production. R. Smallman-Tew. The atomic hydrogen welding process, described at length, is said to combine many of the advantages of both arc and oxyacetylene welding with few of their disadvantages. Discussion covers: comparison of forgings and weldings; arc-welded components; atomic hydrogen welding; atomic hydrogen-welded fittings; and weldings in production. A special testing fixture, designed by the Technical Office, has a capacity of 120,000 lbs. Root end weldings under test are illustrated. *Aircraft Engineering*, August 1941, pages 227–230, 6 illus.

Wind Tunnels

The Lockheed Wind Tunnel. Description of the equipment and operation of the aerodynamics laboratory and wind tunnel of the Lockheed Aircraft Corporation at Burbank, California. *Aeronautics*, August 1941, page 50, 4 illus.

Power Requirements for Wind Tunnel Models. C. C. Clymer. A discussion of the method for determining the size, capacity and design of electric motors for wind tunnels. *Aero Digest*, December 1941, pages 197, 227, 2 illus.

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Government Publications

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Training and Employment Opportunities in Aviation. A 170-page booklet of general information on opportunities for training of all types in aeronautics has been issued by the C.A.A. It groups training into three main categories, pilot training, mechanic training and aeronautical engineering.

Under pilot training, the Civilian Pilot Training Program, its requirements, courses and publications are described and the opportunities offered by the Army and Navy as well as commercial flying schools are outlined. Opportunities for mechanical training and factory employment are similarly presented along with information on sponsored courses in aeronautical engineering for those who can qualify.

Parallel Axes Control-Surface Binary Flutter. A report outlining a method by which the critical flutter speeds of wings and tail configurations for the parallel-axes binary modes can be rapidly estimated. The means employed to achieve this end are a series of engineering charts which determine a "flutter speed factor" as a function of the principal parameters affecting the critical speed. These are: surface weight, elastic axis location, center of gravity location, control surface chord ratio, control surface dynamic balance, structural damping and frequency ratio. *C.A.A. Safety Regulation Release No. 68*, September 15, 1941, 160 pages.

Foreign Materials in the Induction System. Alexander N. Troshkin. A safety bulletin by a Civil Aeronautics Board power plant specialist, dealing with the hazard of foreign material entering aircraft power plant induction systems. The report indicates the probability of damage to the impeller and other parts, resulting in possible power-plant failure, caused by the passing of bolts, cotter pins and other small objects into the blower.

The bulletin cites examples of rags and other foreign objects which were either left in the engine during repairs or blew into the intake during the warming-up period or in flight. Recommendations are made for safeguards and regulations which may minimize this hazard.

Carburetor Icing and Prevention. Alexander N. Troshkin. A Civil Aeronautics Board safety bulletin concerning the cause and prevention of carburetor icing. It outlines the general conditions and the particular temperatures and circumstances in which this type of icing can be expected. General rules are proffered for the prevention of icing and the successful operation of carburetor heating systems.

Photographic Measuring Devices Developed in Two C.A.A. Projects. Description of two new devices used in aircraft certification and now being developed by the C.A.A. One concerns an automatic instrument log, the other entails equipment for measuring aircraft performance. Both of these devices are basically photographic in principle. *Civil Aeronautics Journal*, November 15, 1941, pages 289, 295.

Proposal Trims Flying Time for Non-spin Planes. A study of the proposal to reduce the pre-solo instruction time for students taking instruction in two-control non-spinnable aircraft equipped with a nose-wheel type landing gear. This proposal was made after an experimental training program on this type aircraft was conducted to determine the average of hours of instruction required for a safe solo flight, and the amount of additional dual required to prepare the student to solo a conventional trainer. *Civil Aeronautics Journal*, December 1, 1941, pages 301, 302.

Device Useful in Teaching Air Navigation. H. Lynn Bloxon. Description of a device which may be built out of wood and cardboard to aid in showing avigation students why compass headings differ from true headings. *Civil Aeronautics Journal*, December 1, 1941, page 304, 1 illus.

U.S. Army Air Forces

A Resume of Developments. Maj. Gen. H. H. Arnold. A general outline of the development which has taken place in the Air Forces since the beginning of threatened hostility. This includes progress in enlarging bases, training facilities and equipment as well as increasing numbers of pilots, flight crews and other personnel. Advances in the development of airplane types, the work of the ferry command and similar major activities started by the Army Air Force are outlined. *Air Forces News Letter*, November 1941, pages 1–5, 1 illus.

Welding. A technical manual on the science of welding. An elementary description is given of the equipment and technique used in oxyacetylene, arc and resistance welding and cutting. Their application to steel and steel alloys, ferrous castings, aluminum and its alloys, nickel, copper, etc., is explained. Special attention is given to airplane welding problems, welding tests and the hardening of surfaces. *War Department Technical Manual No. 1-430*, February 20, 1941, 170 pages, 87 illus.

The Air Defense System in Action. Capt. Oliver F. Holden. A study of the air defense net operated by the First Intercepter Command of the Army Air Forces jointly with civilian agencies and the telephone company. The standard procedure for handling reports, determining the identity and direction of the craft and the dispatching of aircraft to intercept and destroy the enemy craft is outlined. *Air Forces News Letter*, November 1941, pages 11, 12, 14.

Airplane Inspection Guide. A concise presentation of the information necessary for the proper inspection of aircraft, engines and auxiliary equipment. Inspection routines for structures, propellers, instruments, hydraulic equipment, engine, electric, induction, fuel and lubricating systems are outlined as well as instruction for filling out the required report forms. *War Department Technical Manual No. 1-415*, March 24, 1941, 113 pages.

National Advisory Committee for Aeronautics

Researches on Direct Injection in Internal Combustion Engines. Jean E. Tuscher. Translation of the paper, "Recherches sur l'Injection Directe dans les Moteurs à Combustion,"

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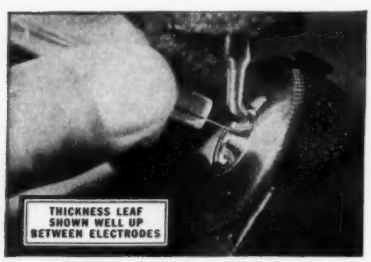

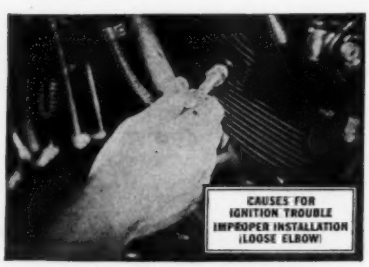

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from *Publications Scientifiques* et Techniques du Ministère de l'Aire, No. 89, 1939. A description of experiments carried out on two different types of engines showing that the laws relating injection and combustion and, finally, the operating qualities of the engine itself, are general and are influenced neither by the shape of the combustion chamber nor by a more or less strong turbulence maintained in this chamber.

The study of retarded cycles, during which combustion takes place entirely during the expansion stroke, has provided a means for reducing the combustion speed and for increasing the concentration of the air-fuel ratio up to saturation while maintaining a high thermal efficiency. The combination of a short injection period and and retarded cycle will produce the greatest specific power from a Diesel engine, while reducing, at the same time, the fatigue of its parts to within acceptable limits.

To sum up, these researches have adduced a solution for reducing the fatigue of the Diesel engine by permitting the preservation of its components and, at the same time, raising its specific horsepower to a par with that of carburetor engines, while maintaining for the Diesel engine its prerogative of burning heavy fuel under optimum economical conditions. *N.A.C.A. Technical Memorandum No. 993*, November 1941, 97 pages.

Effect of Threaded and Serrated Holes on the Limited Time and Fatigue Strength of Flat Light-Alloy Strips. H. Bürnheim. A translation of the paper, "Über den Einfluss von Bohrungen mit Gewinden und Kerbverzahnungen auf die Zeit- und Dauerfestigkeit von LeightmetallFlachstäben," from *Luftfahrtforschung*, March 29, 1941. The investigation was made for the purpose of ascertaining the notch sensitivity of flat strips of light alloy with cylindrical holes under initial tension stress, with special attention to the change in notch-effect factors with the number of load cycles. Then the studies were extended to similar flat strips with pin-loaded holes. *N.A.C.A. Technical Memorandum No. 994*, November 1941, 10 pages, 17 illus.

The Creep of Laminated Synthetic Resin Plastics. H. Perkuhn. Translation of a paper, "Kriechverhalten geschichteter Kunstharzpressstoffe," from *Luftfahrtforschung*, February 28, 1941. The long-time loading strength of a number of laminated synthetic resin plastics was ascertained and the effect of molding pressure and resin content determined. The best value was observed with a 30 to 40 per cent resin content. The long-time loading strength also increases with increasing molding pressure up to 250 kg./cm.^{2}; a further rise in pressure affords no further substantial improvement.

The creep strength is defined as the load which in the hundredth hour of loading produces a rate of elongation of 5×10^{-4} per cent per hour. The creep strength values of different materials were determined and tabulated. *N.A.C.A. Technical Memorandum No. 995*, November 1941, 8 pages, 23 illus.

Two-Dimensional Potential Flow Past a Smooth Wall With Partly Constant Curvature. Werner v. Koppenfels. Translation of the article, "Ebene Potentialströmung längs einer glatten Wand mit stückweise stetiger Krümmung," from *Luftfahrtforschung* for July 20, 1940. The speed of a two-dimensional potential flow past a smooth wall, which evinces a finite curvature jump at a certain point and approximates to two arcs in the surrounding area, has a vertical tangent of inflection in the critical point as a function of the arc length of the boundary curve.

The method discloses that in the vicinity of the curvature jump the assumptions for Pohlhausen's boundary layer equation into which the first two speed derivatives enter, are no longer given. In consequence of the pronounced pressure change at the critical point, a breakdown of the boundary layer is anticipated. *N.A.C.A. Technical Memorandum No. 996*, November 1941, 19 pages, 10 illus.

Determination of the Bending and Buckling Effect in the Stress Analysis of Shell Structures Accessible from One Side Only. A. Dose. Translation of a paper, "Untersuchungen zur Erfassung des Biegungs-bzw. Beulungseinflusses bei Spannungsmessungen an nur einseitig zugänglichen Schalenkonstruktionen," from *Luftfahrtforschung* of March 29, 1941. A report describing a device for ascertaining the bending and buckling effect in stress measurements on shell structures accessible from one side only. Beginning with a discussion of the relationship between flexural strain and certain parameters, the respective errors of the test method for great or variable skin curvature within the test range are analyzed and illustrated by specimen example. *N.A.C.A. Technical Memorandum No. 997*, December 1941, 17 pages, 14 illus.

Inertia of Dynamic Pressure Arrays. Hans Weidemann. Translation of an article, "Zur Tragheit von Staudruckanlagen," from *Luftfahrtforschung* of July 20, 1940. The author states that there is a certain time lag in dynamic pressure changes before they are visible to the pilot on the indicator dial. This lag depends upon the size of the tubing employed and the characteristics of the indicating instrument. A new mathematical term, "pneumatic time constant," which depends only on the dimensions of the tubing and of the indicator, permits the comparison of different dynamic pressure arrays. The pneumatic time constant is an indication of the inertia of a dynamic pressure array. *N.A.C.A. Technical Memorandum No. 998*, December 1941, 14 pages, 7 illus.

Stress Analysis of Circular Frames. H. Fahlbusch and W. Wegen. Translation of the article, "Berechnung der Beanspruchung kreisfömiger Ringspante," *Luftfahrtforschung*, April 22, 1941. A study of the stresses in circular frames of constant bending stiffness as encountered in thin-walled shells. They are investigated from the point of view of finite depth of sectional area of frame. The solution is carried out for four fundamental load conditions. *N.A.C.A. Technical Memorandum No. 999*, December 1941, 11 pages, 19 illus.

National Bureau of Standards

Stresses in a Rectangular Knee of a Rigid Frame. William R. Osgood. A study of the distribution of stress in the knees of a rigid frame. Numerous tests have been made to determine this distribution. But tests alone are, according to this paper, of limited value unless they permit generalization, that is, unless it is possible to predict the behavior of other similar but different structures on the basis of the tests.

One method of generalizing consists of analyzing tests by well-founded theory which is not restricted by particular dimensions of a test specimen nor the conditions of loading. If the limitations of the theory are kept in mind, wide generalization is often permissible. *Journal of Research of the National Bureau of Standards*, November 1941, pages 443–448, 4 illus.

British Library of Information

Airscrews Aid High Altitude Bombing. A study of the variable-pitch contra-rotating propeller which, according to this article, not only permits improved altitude performance but eliminates the need for torque rigging and permits the use of shorter landing gear legs. *Bulletin from Britain*, December 3, 1941, pages 1, 2.

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Current Military History

When the German *Wehrmacht* stopped going forward in Russia and began moving in reverse, even some of the military experts began wondering what the Soviet Union contained, both from the military and the spiritual point of view, that enabled them to resist the blitz and, finally, roll back the Nazi war machine.

Many of these questions are answered in this book. It presents a studied analysis of the German attack to the East, indicating that the *Wehrmacht* found no mere army, when they moved through Russia, but an entire people in arms.

A sober, conservative strength estimate of the Soviet fighting machine is offered. The air arm is discussed with comment on the general construction and armament of popular types of aircraft in current use, the organization that operates them and the factories that keep them supplied in adequate numbers. The organization and operation of paratroops and the *Osoaviakhim*, or civil aviation unit, are likewise explained, as are the mechanized units, supply and industrial facilities, and other major military factors.

Aside from the material considerations of the war, great stress is laid by the author on the invisible elements in fighting; the morale which has repeatedly not only kept encircled units of the Army from surrendering, but has sustained their morale until they were relieved. This depended, in a large degree, on the information units which traveled with each division. The Soviet Army, according to the book, has come a long way from the Czar's units which depended for discipline on illiteracy and fear. Even the trapped units were kept in constant touch with their progress by means of "Wall newspapers"; bulletin board affairs issued by the press officer attached to the unit on portable equipment.

The major message of this work seems to be that the reason for the Russian resistance is far more spiritual than it is material, and that the seeds of the ultimate defeat of Fascism have already been sown in the winter snows before Leningrad and Moscow.

We Made a Mistake—Hitler, by Lucien Zacharoff; D.Appleton-Century, New York, 1941, 213 pages, $2.00.

Books reviewed in this section may be purchased, or borrowed without charge, from The Paul Kollsman Library, Institute of the Aeronautical Sciences, 1505 RCA Building West, Rockefeller Center, New York, N. Y.

Elements of Airplane Lofting

Because lofting is a comparatively new operation in airplane building, a primary discussion of the science may be valuable to seasoned airplane builders as well as to student engineers and apprentice mechanics. Airplane lofting is an admitted adaptation of ship lofting. It inherits most of the older art's mathematics and theory, and many of its terms and methods, but has introduced many alterations of its own because of differences in materials and problems.

The volume opens with a clarification of terms, both lofting and aeronautical, reviews enough plane and solid geometry to make the principles involved in lofting clear, and then plunges into the practical aspects of the problem such as fairing, models and shell expansion.

Continuing along the same lines the author applies this primary practice to the loftsman's final output, templates, which are then put to work on the production of blanked parts which are finally formed and assembled by the use of fixtures, forms and jigs.

One of aviation's own contributions to lofting, the use of photographic equipment for reproduction and transfer is explained. Other newly developed methods of mechanical transfer, used in accelerating the process of lofting, are reviewed.

Airplane Lofting, by William Nelson; McGraw-Hill Book Company, New York, 1941; 148 pages, $1.50.

Instructor's Aviation Manual

An outline is provided in this manual for a brief course in elementary navigation to include both references and texts prepared especially to meet the requirements of the Civilian Pilots Training Program. It is broken down into 12 lessons covering such subjects as definitions, size and shape of the earth, and details on aeronautical charts and their use.

Other suggested material includes a study of the magnetic compass, methods of determining deviation, tables and diagrams, practical air piloting, the theory and practice of dead reckoning and correction for draft. A detailed study of the radius of action of aircraft is also offered.

The work suggested in navigation by radio brings the course up to date since it includes work in radio range flying, along with the use of fan type markers. Explanation of the use of the Dalton computer is also included.

Air Navigation Outline, by Frederick W. Keater; Weems System of Navigation, Annapolis, Maryland, 1941; 96 pages, $2.50.

Another Year in Aviation

Another review of the year's progress in aviation, written by the famous *New York Times* team of Graham and Cleveland. Following their established formula of inspecting the industry under such headings as military and naval aviation, commercial flying, meteorology manufacture, schools, research, instruments and airports, their presentation this year is unusually thorough, considering the fruitful period it has to cover.

The military and naval sections, naturally, are long, well illustrated and comprehensive. The chapter on air transport, featuring a simplification of the Wilbur Wright Lecture, given by Juan Trippe of Pan American Airways before the Royal Aeronautical Society, contains a popular version of the *Hogozit Curve*, a system of presenting the progress of a transoceanic flight while in operation, as developed by Capt. Harold Gray.

The manufacturing and private flying portions of the work are excellent, evidencing that they are not being shouldered out in presentations to youth by the more spectacular military interests. One of the unusual features of the work is the picture-visit to the wind tunnel at Langley Field. The making of the blades for the wind tunnel fan is illustrated progressively.

Young America's Aviation Annual, by Frederick P. Graham and Reginald M. Cleveland; Robert M. McBride Company, New York; 1941, 254 pages, $2.00.

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C. W. Glover, 1941—$16.50
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WARTIME BUILDING CONSTRUCTION
1st American Edition, 1941
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This book reviews the general principles of wartime building.
It stresses the degree of fire protection required and the best means of carrying out the work.
There is a special section devoted to the construction of single story buildings to provide living quarters for armed forces, also for temporary office accommodations and hospitals.

AVIATION INSTRUMENT MANUAL
1941—$5.00

This publication describes the construction, use and maintenance of instruments, used in aeroplanes and of instruments used on the ground associated with those in aeroplanes.

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North Island Memories

A moving, vivid account of life at a modern naval air base, the book by this name presents the social, human and military phases of training, maneuvers, squadron and social life, afloat and ashore.

The writer, currently test pilot for Vought-Sikorsky, gives a highly personalized review of the experiences of a Pensacola graduate who is ordered to a dive-bomber squadron attached to the aircraft carrier *Lexington* and shore-based at North Island. The account covers three years' connection with the station and several short trips up and down the coast as well as one major cruise aboard the carrier.

The entire story sparkles with Navy jargon and contains sharply etched portraits of the men who make up the personnel of the Navy Air Service. The reader has an opportunity in this work of becoming more intimately acquainted with the spirit of the Naval Air Service as fostered in the tightly centered naval aviation community at North Island.

Air Base, by Boone T. Guyton; Whittlesey House, New York, 1941; 295 pages, $2.50.

Dynamics of the Air

The progress of meteorology has been due in recent years to the application of the laws of thermodynamics and hydrodynamics, the study of the atmosphere and its motions. This book gives an account of these investigations and their results with regard to application to forecasting and to meteorological research. It presents a concise treatment of the laws that operate in the atmosphere, stressing the results of dynamic meteorology and their importance to actual forecasting.

While the work assumes a certain amount of mathematical background, it retains a definite simplicity which makes it possible for the untrained reader to understand it, if read carefully. It commences with a study of the earth and the equation of state for dry and moist air. A study of atmospheric statics, condensation and adiabatic changes in moist air is followed by further application of thermodynamics to the atmosphere. Radiation and atmospheric motions as well as analysis of the pressure field are presented along with studies of general circulation in the atmosphere, fronts, air masses, and pressure phenomena.

The appendix contains such tables as saturation pressure of water vapor, millibars, numerical constants, etc.

Dynamic Meteorology, by Bernhard Hauritz; McGraw-Hill Book Company, New York, 1941; 365 pages, $4.00.

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Radio and Instrument Flying by Charles A. Zweng, Instructor, U. S. AIR CORPS. 1941. Third Edition bristling with important new material. Written especially to prepare the pilot for government examination for "instrument rating." Radio-Telephone Permit included with Meteorology, Radio-Orientation, let-down, off-course and alternate airport problems. Only $4.00 postpaid.

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British Engine Practice

Providing an index to the considerable difference between British and American procedures, this work offers a general description of British maintenance and overhaul system. Part of a series on British aircraft construction, operation and maintenance, it launches the subject by a general review on British ground engineers' licenses, their categories, qualifications and responsibilities.

A chapter on engine types and operations gives a lucid explanation of the function of the various engine parts and contains an excellent simplification of the British sleeve-valve engine. The general outlines of engine installation and servicing procedure, trouble-shooting, top overhaul methods and testing procedure further accentuate the dissimilarities between U.S. and British methods, provoked by differences in service conditions.

Material is also included on other subjects such as engine ratings and performance testing, hand and mechanical starting with explanations of various types of British starters and the use and function of aircraft instruments.

Aero Engine Practice, by E. Molloy; Chemical Publishing Company, Brooklyn, New York, 1941; 132 pages, $2.50.

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Simplified Meteorology

In this book the author has sought to explain the basic truths and principles of meteorology without mathematical formulas, complicated diagrams, advanced physics or higher mathematics, to the end that the average pilot might be able to use the airways with increased safety.

Introducing his work with a study of the characteristics and composition of the atmosphere and the elements of meteorology, pressure tendency, humidity, cloud formation, etc., the author describes the instruments used to measure them and their functions. Cloud types and their formations, circulation, front developments and their effect are discussed in an examination of weather maps, reports and forecasts, and their interpretation for safer flying.

A Pilot's Meteorology, by Charles Greham Halpine; D. Van Nostrand Company, New York, 1941; 220 pages, $2.50.

Layout in Aircraft

There are three chief fields with which every good aircraft layout draftsman should be familiar. They are descriptive geometry, detail design and fitting analysis. This work is a practical introduction to all three of these. It is written from the point of view of the teacher who must present it to a class, and that of the detail draftsman who wants to assume higher responsibilities.

Besides reviewing the actual mechanics of making layouts, the basic descriptive geometry applied in the work is set forth. Enough practical information is given on aircraft parts, design considerations and actual fabrication procedures such as forging, molding, riveting, etc., to promote intelligent design drafting.

The general field of fitting and stress analysis is treated on the same basis, as is a primary study of the design of thin web beams. The final section provides for the layout man such general tables as bending allowances, decimals, logarithms, square roots and the like.

Aircraft Layout and Design Detail, by Newton H. Anderson, McGraw-Hill Book Company, Inc., New York, 1941; 306 pages, $3.00.

Aircraft Welder's Primer

This book outlines a training course for aircraft welders, covering the usual basic subjects of welding, brazing and soldering by various gas media. An introduction to the science of welding gives the definitions and describes the standard equipment, explaining the function of each part. The presentation then treats of safety rules on the operation of the equipment, procedure in the use of gas, setting up and lighting the torch, establishment of correct flame and the actual heating and welding procedure.

Particular attention is given to the design, building and use of jigs in aircraft welding. Detailed discussions are provided on government specifications, routine tests and examination for the hiring and certification of welders, and the usual routine by which their work is inspected and judged. Final sections deal with directions and precautions for welding in aircraft repair and maintenance.

Aircraft Torch Welding, by C. Von Borchers and A. Ciffrin; Pitman Publishing Corporation, New York, 1941; 157 pages, $1.50.

Physical Examination

The authors, one a well-known flight surgeon and the other a former Navy pilot, editor and executive, offer a handbook containing the basic physical test given by flight surgeons to all who wish to fly.

The tests, which usually require complicated equipment have been simplified and reproduced through the use of charts, cellophane discs, measuring scales that can be removed from the book, color plates and similar props. One of the unusual features is the depth perception gage, customarily a cumbersome and expensive device. The makeshift that can be made to perform its function will amuse and startle some of the veteran pilots who have known it in its official form.

Are You Fit to be a Pilot! by Dr. Ermin L. Ray and Stanley Washburn, Jr.; Wilfred Funk, Inc., New York, 1941; 62 pages, $1.75.

British Engine Accessories

Another in the Molloy series on British maintenance methods, this work deals with the main types of starters and generators used generally in English operations. The types studied include the Rotax, B.T.H. and Armstrong Siddely types of hand turning, inertia and electric starters.

Following the usual handbook style, the operation and function of each type is outlined and practical suggestions for installation and maintenance are offered. Part of the book is devoted to the gas and compressed air starters which are seldom used in the United States but are quite common abroad.

Starters and Generators, by E. Molloy; Chemical Publishing Company, Brooklyn, New York, 124 pages, $2.50.

Allied Military Aircraft

Presenting a series of photographs and comprehensive descriptions of most of the types of military aircraft being used by the United States and England in the present conflict. This book does not contain the very latest types, but it is sufficiently up to date to offer a fairly clear panorama of the equipment on hand.

The book is broken down into general units in which the various functions of aircraft are presented. Pursuits and fighters are treated first, offering descriptions of types in current use, some of which were considered "brand new" up to the last summer. These include the Airacobra, the Curtiss P40D, the Grummann Sky Rocket and the Republic Thunderbolt. In all cases the information on British Aircraft is not quite as modern.

Medium and light bomber, dive bomber, heavy bomber and the twin and 4-engine class and the various types of naval aircraft are similarly presented. The most modern material is found in the training liaison and miscellaneous section of the book. Some of the less discussed types, such as the Ryan YO51, the Stinson 049, the British Air Speed Queen Wasp and other less popular types are presented. While the book offers no outstanding information it does serve as an omnibus of military types up to the point of its publication.

War Wings, by David S. Cooke; Robert McBride and Company, New York, 1941; 218 pages, $2.75.

Model Engineering

This book fills a long vacant place on the aeronautical book shelves. It applies the known and accepted principles of airplane design to the problems of model airplane construction. It is accomplished with a clear understanding of the nature and capacity of the American model airplane builder acquired by the author through his experience and contacts as editor of the Model Airplane News.

The tendency among many writers is to underestimate the engineering capacity of young people but this author in his work sufficiently simplifies the mathematics used to make it handy for his readers. Nevertheless, he has left enough substance to make the mathematics applicable to the job on hand. The work is divided into six major sections. The first deals with the essential factors of flight, basic information on lifting surfaces and their inherent mathematics and calculations.

Among the unusual features is a clear simplification of the graphic method for determining speed. Another section is devoted to stability in the method for obtaining it. The study of propellers in their proportion, and comprehensive data on rubber and gasoline power for models are explained.

The latter half of the book is devoted to the application of the foregoing principles to actual design: the arrangement of aerodynamic factors and the actual procedure in designing several types of models such as stick models, speed, distance and duration designs. Advance applications of this work are grouped in a paragraph on the design of gas models. The final section concerns control, adjustment and balance before and after test flights.

Model Airplane Design and Theory of Flight, by Charles Hampson Grant; Jay Publishing Corporation, New York, 1941, 512 pages, $3.75.

An Amazing Saga

With a view to portraying the "Amazing Saga" of air transportation, a director of Eastern Airlines, Inc., has written a small volume which tells briefly the history of air transportation and its contributions to modern transportation; it highlights the technical progress which has aided the airlines in making air transportation safer, quicker, cheaper and more dependable. Final sections pose the more important business problems of air transportation and

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point out the future of the industry.

The author finds that the industry's beginnings in a world of abundant and keenly competing transportation facilities and its astonishing growth in a brief span of years were accomplished not because of greater comfort, safety and dependability, but because of speed—speed in the carriage of mail, people and goods. He says that "it must deliver more speed than its competitor in order to survive, and to the extent that it does deliver more speed it thrives in the carriage of that to which speed is important."

Remarking that speed is important in the carriage of mail and important more often than not in the carriage of people, he suggests that the carriage of goods may or may not be important. For example, there are certain types of freight to which it will never be important. To other types, speed is less important today than it used to be, as in the case of fresh foods which can now be refrigerated in transit.

The future of air transportation is held to lie in the exploitation by enterprising airlines traffic departments of the numerous sorts of merchandise which are suitable to the speediest transportation possible. It is on this note that the writer frames the ideal of the industry—not to supplant surface transportation, but to join it in full-fledged maturity as a major part of the country's transportation system.

Air Transportation in the United States, by Hugh Knowlton; The University of Chicago Press, Chicago, 1941; 69 pages, $1.25.

Meteorological Media

In an attempt to provide a general textbook on meteorological apparatus and methods in a summary work, the author has probed British and American practice to bring up to date not only the developmental background of the subject but the numerous improvements in meteorological apparatus developed in Canada. As meteorologist in the Meteorological Service of Canada, he has undertaken to correlate the best practice in each country and to improve the entirety by a study of other methods.

Based on the author's lectures of the past six years at the University of Toronto, the work emphasizes the underlining principles of the subject and sets down a number of practical matters with which a practicing meteorologist should be familiar. The scope is restricted to include only those instruments found in meteorological stages, omitting other instruments used by only a small minority of meteorologists. The most notable weakness is in the section on radiosondes which apparently was handled summarily in order to avoid lengthy discussions which may likely become obsolete by rapid and unforeseen improvements.

Prepared as a text, the material is organized into the usual introduction, and general sections on the measurement of atmospheric pressure, temperature in meteorology, atmospheric humidity, precipitation and evaporation, wind near the surface, and upper winds by means of pilot balloons. Other portions treat of instruments for investigating clouds, recording sunshine and the investigation of the upper air. Each division is broken down into a reasonably detailed study of the variety of instruments pertaining to the specific field.

A number of references to original papers selected from the quantity of literature on the subject supplant a supporting bibliography. Mathematical demonstrations involving the simplest and most differential equations, generally only elementary calculations, make the non-mathematical parts of the book clear for those who do not wish to work through the theory. General history of the subject has been omitted as satisfactorily covered in other sources.

Meteorological Instruments, by W. E. Knowles Middletown; The University of Toronto Press, Toronto, Canada, 1941; 206 pages, $3.25.

Book Notes

Sky Hostess, by Betty Peckham; Thomas Nelson & Sons, New York, 1941; 84 pages, $1.75.

A glamorous presentation of the career available to young women who can qualify as airline hostesses. Requirements for applicants are outlined along with the duties and recreational advantages of the occupation.

Most Used Aviation Terms, compiled by Harold E. Baughman and John Robert Gregg; Gregg Publishing Company, New York, 1941; 40 pages, $0.80.

A dictionary of 1,000 most common aeronautical terms defined and written in the Gregg system of shorthand. The definitions are reprinted from Baughman's *Aviation Dictionary and Reference Guide.*

The Destiny of Sea Power and Its Influence on Land Power and Air Power, by John Philips Cranwell; W. W. Horton & Co., Inc., New York, 1941; 262 pages, $2.75.

An interpretation of the modern concept of sea power and its rôle in modern warfare, this book points out parallels in sea power, air power and mobile land power that are so fundamental that they create a new "trinity" of war. In this trinity, sea power is said to set the pattern. Land forces and air forces are held to be now finding themselves following naval strategy in maneuvering the weapons of tanks and airplanes. The necessity for coordinating the function of these three elements is emphasized with pointers on the types of airplanes and tanks which will have to be evolved to meet it.

He's in the Navy Now, by John T. Tuthill, Jr.; Robert M. McBride and Co., New York, 1941; 256 pages, $2.50.

An expository picture of the U.S. Navy in action—in training and at sea. Many illustrations. The work of the naval air units and aircraft carrier operations are reviewed here and there.

Motion Study, by Herbert C. Sampter; Pitman Publishing Company, New York, 1941; 152 pages, $1.75.

A practical exposition on the nature of motion study, its objectives and applications. The use of flow charts to eliminate study of superfluous operations is emphasized, with explanations of how to make charts that record what is being done. These apply to flow of materials, to simpler tasks such as janitor and repair work, and to individual work requiring the study of hand motions. The distinctions between time study and motion study are brought out.

Radio Troubleshooter's Handbook, by Alfred A. Ghirardi; 2nd edition, Radio and Technical Publishing Company, New York, 1941; 708 pages, $3.50.

This revised and enlarged edition attempts to provide radio service men with a complete coverage of the mass of practical information which is a constant and important necessity in radio service work. Increased by some 40 per cent, the text includes the latest data concerning current equipment and servicing practice.

An Introduction to Television, by C. J. Hylander and Robert Harding, Jr.; The MacMillan Company, New York, 1941; 207 pages, $2.00.

A simplified explanation of the complexities of television, this work scans its developmental history, defines the scientific and mechanical principles on which it depends, and describes the nature and use of the instruments used in televised transmission and reception. The future for this field of communication is prognosticated.

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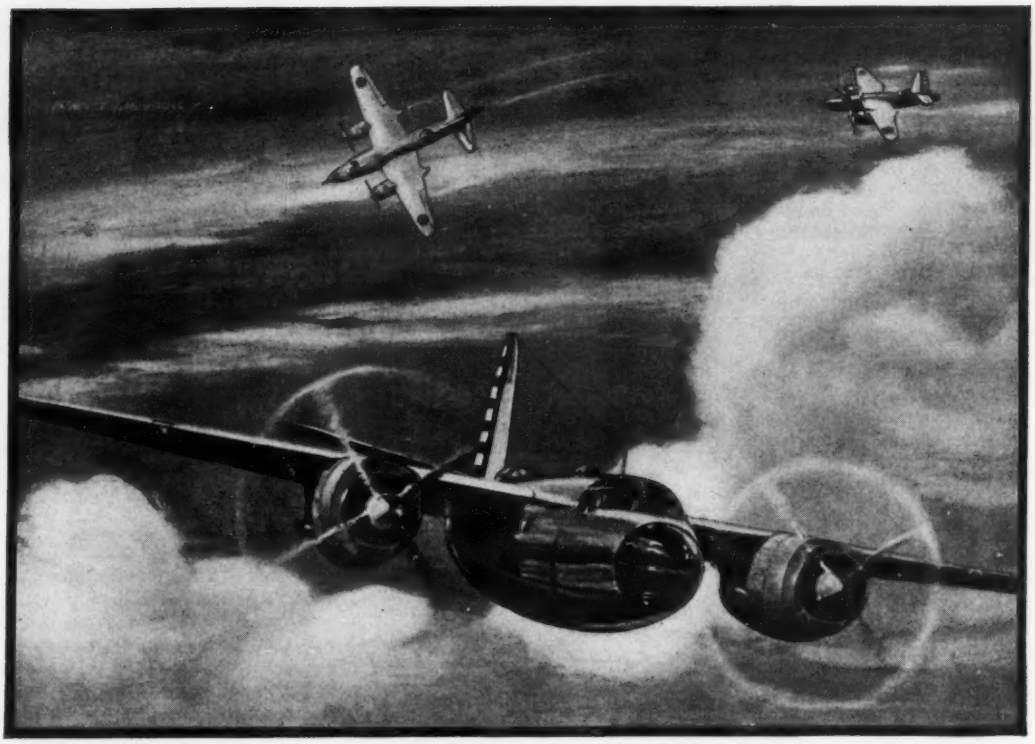

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House Organs and Catalogues

Plastic Fabrication

Plexiglas Fabrication Manual. A 48-page booklet of general instructions on the handling, shaping and repair of Plexiglas and windshields and other transparent plastic used in aircraft. Directions are given for storing the the sheet plastic, removing the masking, machining, forming, cementing, cleaning, finishing and repairing sheet Plexiglas articles. *Röhm & Haas Company*, Philadelphia.

Propeller Blade Description

The Design and Manufacture of Hollow Steel Propeller Blades. H. P. Reiber. A study of the history of propeller blades leading up to the development of the modern hollow steel type, and a general description of the process for fabricating these from internally polished and swaged seamless steel tubes. This process was evolved by the Lycoming Division of the Aviation Manufacturing Corporation.

The tube is upset and turned to a proper thickness, leaving one wall thicker than the others to allow for the fabrication of the leading edge. Then, by successive steps, it is bent, flattened and contoured, its tip shaped and welded. The blade is then finished and balanced, attached to the shank and geared for insertion into the hub. The various inspection systems and the tests to which the blades are submitted are described, as well as the machinery for producing the blades in quantity. *Lycoming Division, Aviation Manufacturing Corporation.*

Weight Engineering

Weight Predictor. Creighton Merrell. An introduction to a little-publicized phase of airplane construction, that of weight engineering. This department must begin predicting the weight of the future airplane from the three-view drawing stage, and keep it within one-half of one per cent of the contracted weight.

This task, according to the article, is a constant struggle between the production department and the customer, one wanting less weight for greater payloads, the other wanting increased weight for easier production. How the weight unit engineer functions from the time the airplane is ordered until it is finally weighed-in is described, and specific examples of problems encountered during production are given. *Boeing News*, November 1941, pages 2–4, 5 illus.

Conveyor System

Production Lifeline. An illustrated inspection of the stock conveyor system at Bell Aircraft which distributes material and stock parts to the various production departments. The system by which these materials are scheduled to arrive where they are wanted without loss of time is described. It consists of 4,631 ft. of overhead rail with conveyor trays suspended from it at thirty-foot intervals. The trays, moved by a continuous chain, traverse the 23 stations at the speed of 30 feet per minute. *The Bellringer*, December 1941, pages 4, 5, 6 illus.

Defense of the P-40

The Other Side of the Question. Since the outbreak of hostilities in Europe, many criticisms have been leveled at the Curtiss P-40 type of pursuit airplane. The secrecy demanded by both the British and our own air forces has prevented the Curtiss-Wright Corporation from answering these comments. This article is a carefully written survey designed to answer these criticisms but avoiding such figures on airplane performance as might be valuable to the enemy.

A review is made of the progress of the modern Curtiss pursuit monoplane from its original form as the twin-row Wasp powered model 75, through its various stages of evolution to the P-40 F. Increases in speed, climb, performance and fire-power achieved since 1935 are noted. *Curtiss Fly Leaf*, September-October 1941, pages 3, 4, 6, 5 illus.

Equipment Catalogue

A completely revised loose-leaf catalogue of all the aircraft products manufactured currently by the *Bendix Aviation Corporation* and its various divisions and subsidiaries was issued recently through the company's export division.

The catalogue contains descriptions, specifications and illustrations of all the Eclipse accessories, Pioneer instruments, Bendix landing gears, Stromberg aircraft carburetors, Scintilla magnetos and spark plugs, Bendix aircraft radio equipment and general accessories.

Light Variable Propeller

Roby's New Propeller. Description of a new type of variable pitch propeller manufactured by Roby, Inc., of Wichita. The propeller, built for light engines up to 80 hp., weighs 25 lbs. and can be installed by any licensed mechanic without adjustment to the engine itself. The pitch range is 7°, 3.5° on each side of neutral. *AOPA Section*, December.

Propeller Handbook

Instructions for Installation and Maintenance of the Aeroplane Propeller. A loose-leaf handbook of 56 pages giving service and overhaul instructions and containing a parts catalogue for the Aeroprop, a hydraulically operated constant speed propeller with hollow steel blades, contained entirely in a single unit.

The technical material contained in this handbook includes detailed description of the blades, pitch-changing mechanism, regulator and other parts, instruction for installation, instruction for operation, lubrication, maintenance, disassembly, repair, assembly and overhaul. *Aeroproducts Division*, General Motors, Detroit.

Engine Instruction Book

A loose-leaf book of instructions on the installation, operation and maintenance of the Wright Cyclone 14 model C14B aircraft engine has been issued by the *Wright Aeronautical Corporation.* Following the usual procedure in the handling of this type of information, the book gives a general description of the engine and its function and furnishes instructions for starting and normal operation. Directions are also given for final assembly and for general trouble-shooting, routine inspection and overhaul.

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From the Industry

Civil Aeronautics Administration

A new wall map, designed especially for use in planning mass training flights, has been prepared by the Flight Information Section of the Civil Aeronautics Administration and will be issued quarterly. It is a chart of the federal airways system and contains positions of the navigational aids and data covering every aeronautical radio station in the continental United States, with the exception of airline stations.

The chart is to be used in connection with "Air Navigation Radio Aids," a booklet issued monthly by the C.A.A. in which is tabulated information on minimum safe altitudes for flight, mileages between radio fixes, and the locations of danger areas. An alphabetical listing of station identifications, a statistical summary of all C.A.A. radio facilities, control airports, airway traffic control centers and telephone numbers of C.A.A. communications and Weather Bureau aerological stations are also included in this publication.

Establishment of seven centers for training airport and airway traffic control operators was announced recently by Donald H. Connolly, Administrator of Civil Aeronautics, as the C.A.A. prepared to take over additional airport traffic control towers. The training will take place at New York, Atlanta, Chicago, Fort Worth, Kansas City, Santa Monica and Seattle.

Eight towers were put under C.A.A. management during November; 19 will be taken over during January. Funds are available for C.A.A. management of 12 others to be taken over at a later date. Locations will be selected from a list certified by the Secretary of War or the Secretary of the Navy.

C.A.A. control of traffic at airports was directed by Congress at the request of the War Department and has been accomplished with the consent and cooperation of the municipalities concerned. Growth of military flying on many of these fields presented a problem in traffic control which was best solved by the C.A.A. acting in the interest of both civil and military aeronautical development. In addition, control of traffic at airports by government personnel unifies and improves

Releases are edited as received from companies and other aeronautical organizations and the responsibility for the accuracy of all statements is therefore not assured by the Aeronautical Review.

control of all traffic on the airways network, which is the province of the C.A.A.

Classrooms will be designated by the regional managers in the seven cities concerned. Initial training will consist of four weeks' theory to be followed by practice in the operation of an airport control tower and the supervision of air traffic into and out of an airport. Applicants must possess a private pilot's certificate, or one of higher grade. The experience requirement is 18 months of actual experience in the field of air traffic control, or high school or college education as a substitute for the experience. If an applicant has had no actual experience, he may substitute one year of such educational experience for each three months of actual experience required. Thus an applicant with as much as two years of college training need not have had previous air traffic control experience.

Qualified personnel on duty in towers being taken over will be offered employment by the C.A.A. on a probational basis.

National Aeronautic Association

Plans for the nation-wide development of junior aviation through a consolidation of the two main groups in this field have been announced in a joint statement by Winthrop Rockefeller, Chairman of Air Youth of America, and Gill Robb Wilson, President of the National Aeronautic Association.

Air Youth of America will become a division of the National Aeronautic Association with headquarters in Washington. The N.A.A. Academy of Model Aeronautics will continue as a part of the Air Youth Division and will function in the new set-up substantially as at present, furnishing technical guidance and setting rules for model airplane contests and meets. A group of prominent aviation and youth leaders will supervise the combined activity. Dr. James E. West, Chief Scout Executive of the Boy Scouts of America, has heartily endorsed the consolidated program.

One of the main functions of Air Youth of America has been to prepare educational material for use both by instructors and by youth clubs. The Academy of Model Aeronautics has some 500 affiliated model clubs with a combined membership of 250,000. It has 400 leader members capable of conducting meets and directing youth activities, plus 12,000 licensed model builders as associate members. The Academy's contest board makes rules assuring safety, fairness, and uniformity of records in model contests, meets, and record trials. Thus the work of the two units coincides completely.

Society of Automotive Engineers

Forty-two aircraft-engine standards were recently approved by the Aeronautics Division of the Society of Automotive Engineers' Standards Committee, within eight months of the inauguration of the extensive project, the Society has announced.

Initiated immediately after receiving a request from the Office of Production Management on February 28 to develop standards in the aircraft industry, the task was divided between four subdivisions, serving as steering committees, and 34 subcommittees, each charged with a specific assignment. More than 130 aeronautical engineers representing the aircraft, aircraft engine, propeller and accessory manufacturers and airline operators are actively serving on these committees. In addition, the Army and the Navy are actively participating in the work through the cooperation of the Aeronautical Board. The Civil Aeronautics Authority is also collaborating in the many phases of the program where safety in flight is involved.

The recently-approved standards referred to pertain not only to problems

of interest to the aircraft-engine manufacturers, but also to matters of broad significance to the entire aircraft industry, both military and commercial. The standards recently approved include: altitude graph sheets for the presentation of aircraft-engine performance, carburetor control connections, carburetor flanges, propeller shaft ends, tachometer drives, magneto drives and mounting flanges, aircraft-engine bolt heads, aircraft-engine screw heads, aircraft-engine hexagon nuts, lockwire, cotter pins, procedures and equipment for the preparation of engines for shipment and storage to prevent corrosion, and definitions of aircraft-engine terms, as well as symbols and sketches for pressures and temperatures in an aircraft-engine induction system.

In the development of these standards, membership on each subcommittee on a particular specialized subject was determined on the basis of the selection of the most capable experts available in the entire industry. Each subcommittee was responsible for coordinating its recommendations with all interested manufacturers and users as well as the proper government agency before submitting the proposed standard to the parent committee, which in this case was the Aircraft-Engine Subdivision. In the process of development of these standards all interested parties were consulted and decisions then reached by the committee. These proposals were in turn transmitted to all interested aircraft-engine manufacturers in order to obtain their comments or approval.

All adverse comments were in turn summarized by the Aircraft-Engine Subdivision and referred back to the individual subcommittees for further consideration and appropriate recommendations. Standards presented and approved by the Aeronautics Division at its meeting on October 31, represent the final recommendations of each responsible subcommittee after due consideration of all comments received.

Although this represents the first group of standards completed, each committee still has an extensive program of work in process and additional standards will be completed and approved during the next few months as rapidly as the work can be handled.

Abrams Instrument Company

Designed to speed up and increase the efficiency of aerial photography and reconnaissance in both the commercial and military aviation fields, the Abrams Instrument Company of Lansing, Michigan, has announced its new Model MA-1 Camera Mount. The device, which is in effect an automatic leveller and remote control, has three primary functions: elimination of the routine duties of the aerial cameraman, providing for remote control of the camera from any part of the survey or reconnoitering craft, and increasing the accuracy of aerial surveying. The newly-perfected mount will allow for the placement of an aerial camera on any part of the airplane inaccessible to an operator.

Army Air Force tests at Wright Field, Dayton, Ohio, have indicated that the automatic mount provides for greater accuracy in aerial photography than would be the case if similar pictures were taken through manual effort. The automatic levelling is accomplished by means of photo cells which are adjusted in such a way that, should the camera get off level more than a quarter of a degree in any axis, the motor controlling that axis immediately brings the camera back to true level. The timer for controlling the interval between exposures is an integral part of the mount, thus eliminating the necessity for more than one wire running between the control box and the mount proper.

The Autogroom Company

The fact that an airliner may pick up as much as 50 lbs. of additional weight during five days of rainy weather, and the fact that this condition

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is being reflected in increased operating expense and decreased payload revenue, has tended to make airline operators more "weight conscious" than ever, according to Robert E. Sargent, vice-president of the Autogroom Company of New York City, in a recent address before the Society of Aeronautical Weight Engineers.

Mr. Sargent, whose company specializes in a new and successful drywash method of airplane cleaning, pointed out that the approximate value of a payload pound, or its potential earning power for a year's period, is $55. He said that since the average gross weight of a transport is 24,000 lbs. of which 8,000 lbs. represent useful weight and 4,000 lbs. represent payload weight, it is not difficult to appreciate the seriousness of the economic loss of this added 50-lb. weight, which, at the rate of $55 a pound, may be so quickly translated into a loss of $2,750 in revenue for each individual plane.

Mr. Sargent made five important recommendations which he urged aeronautical engineers to incorporate in maintenance control. They were as follows: Remove all foreign grease and oil around motors, exterior and interior surfaces of wings and fuselage. This accumulation alone can build up to a 10-lb. total. Thoroughly vacuum clean the interior of the cabin. An amazingly high total of dust poundage has been discovered after transcontinental runs. Dry clean removable rugs and upholstery frequently since several pounds may be saved here. Check under floor boards of cabin for accumulated sand and gravel, particularly at weighing time. Exercise particular caution over newly-tarred runways. Underside accumulations here have been known to total as much as 5 lbs. of tar and gravel several times a year.

It was also pointed out that since the greater percentage of the 50-lb. weight surplus which the airliner has been known to pick up during 5 days of test flying in rainy weather is believed to be moisture in the soundproofing and in channels that cannot be dried out, the operator is immediately confronted with the problem of how much water is picked up due to washing of the airliner.

Water weighs approximately 8 lbs. to the gallon. When used under pressure, four gallons could be easily absorbed or hidden in accessible areas, thus giving an increase of about 32 lbs. to the ship.

Fidelity Machine Company

A new type of horizontal hose reinforcement machine, developed to produce tubing and hose for airplane controls as well as for many other industrial uses is now available, according to its manufacturer, the Fidelity Machine Company of Philadelphia. The machine knits four to six feet of wire and fabric reinforcement per minute over synthetic rubber inner tubes on steel mandrels in one operation.

Standard 50-ft. mandrels can be used. These pass over rubber-covered tension feed rolls through a knitting head equipped with latch needles supplied by four cones of yarn and one or two spools of wire. Fabric and wire reinforcement, knitted in one operation, makes a tough, flexible and more nearly non-kinking hose or tube. Mandrel with knitted cover is then drawn out of the machine over a set of rubber-covered tension wheels operating from the same drive and at identical speed to that of the feed rolls. The hose or

Tail cones of Ryan trainers, stocked for future use at the Ryan Aeronautical Company's plant, San Diego.

tubing is then ready for rubber impregnation and vulcanizing.

Manual speed adjustment, controlled by tension applied to belt drive, governs rate of speed. Interchangeable knitting heads, easily removed and replaced, adapt the machine to hose or tube diameters up to 2 in. in diameter and simplify the change-over.

The Guardian Electric Manufacturing Co.

A new series 195 DC midget relays, designed to provide maximum control in minimum space and particularly suited to aircraft and radio work because of their small size and light weight, has been announced by the Guardian Electric Manufacturing Company.

Maximum contact capacity of the Series 195 midget relay is approximately 150 watts, measured at 110 volt, 60 cycle, non-inductive AC. The manufacturer reports that in a number of present aircraft applications, the contacts on the new midget are making and breaking 3 non-inductive amperes at 28 volts DC. Maximum contact combination available is double pole, double throw.

Other features of the midget relay are claimed as follows: With a 2-watt coil, and single pole, double throw contacts in the de-energized position, the normally closed contacts withstand vibrations of six times gravity (6 G's); the normally open contacts withstanding 10 G's. In the energized position, the contacts withstand 10 G's. Relay coil in the series 195 midget relay is available for any voltage up to 75 volts DC—maximum resistance 3,000 ohms—average power requirements of the coil being 2.5 watts.

Simply and sturdily constructed throughout, a light armature operates the contacts which are mounted on and insulated (900 Hi-Pot. Test) from the field piece, through a direct lever action. Coil and contact terminals are solder lug type, tinned for easy soldering. Contact blades are tinned phosphor bronze with contact points of fine silver. Field piece and armature are annealed magnetic iron. Coil is varnish impregnated and baked. Weight with single pole, double throw contacts is .85 oz.

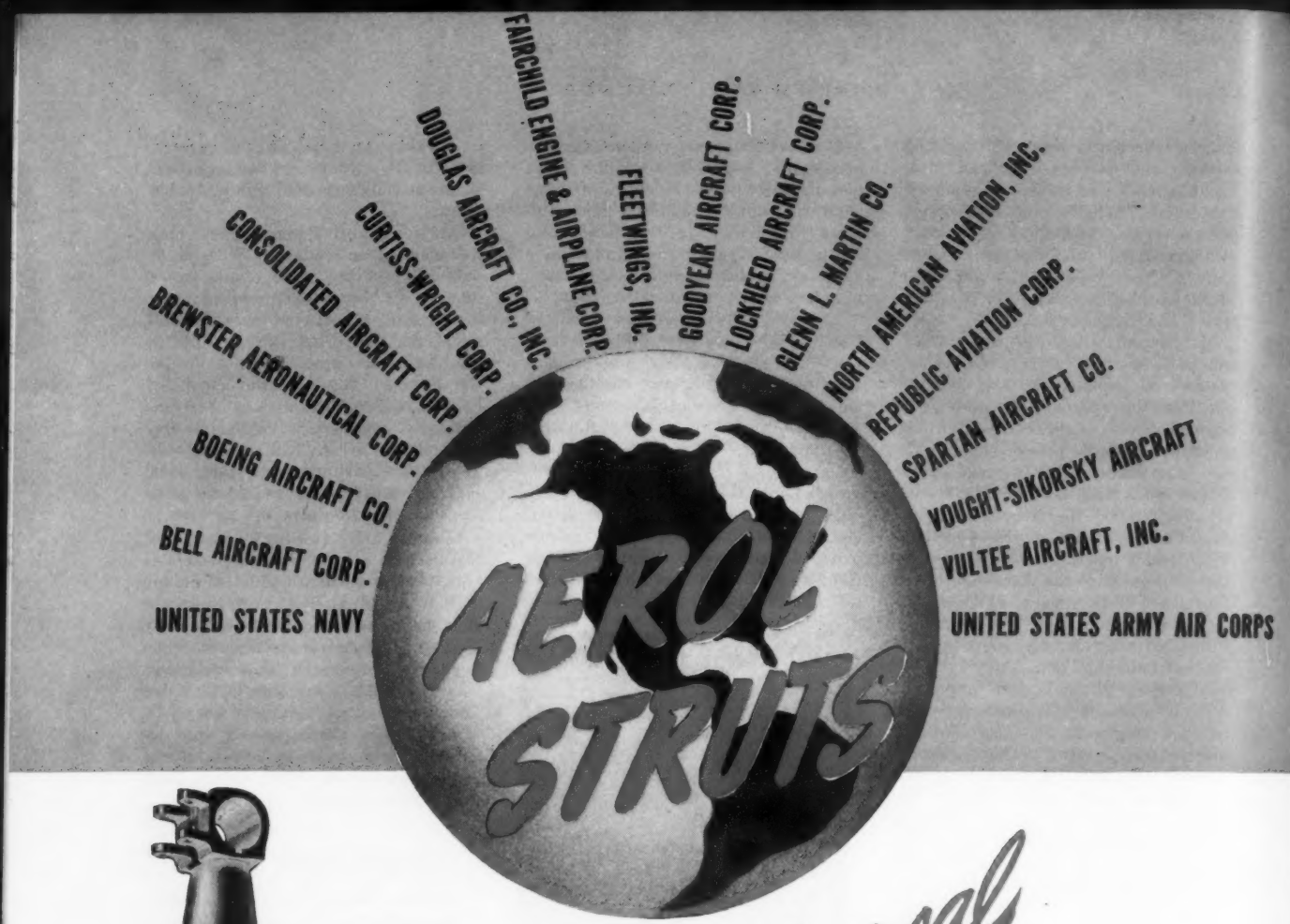
General Electric Company

A complete line of G-E motors in fractional-horsepower frame sizes, designed to meet the requirements of aircraft service, has been announced by the General Electric Company. Designated as Types BA-25, -40, -50, and BC-21 and -31, these direct-current motors can be furnished in series, compound, or shunt-wind to meet varied applications. Ratings range from $^1/_{300}$ h.p. at 7,500 r.p.m. continuous, open, to seven h.p. at 7,500 r.p.m. totally enclosed, no cooling air over the motor, one minute intermittent duty.

The motors, which have been available to aircraft manufacturers for some time, are available in five standard speeds—1,750, 2,800, 3,800, 5,800, and 7,500 r.p.m., although other speeds can be furnished. The motors can also be supplied in either 12- or 24-volt construction.

Construction features include aluminum frames for light weight, magnesium castings being used where weight must be held extremely low, bolted-in pole pieces, precision balance, all ball-bearing construction, and standard Air Corps flange mountings in styles II, III, and IV. Standard shaft extensions are plain, but can be obtained with cut spline or other special features.

The motors are equipped with AN-3102 connectors, but leads can be brought out through the side of the motor and held in place by a rubber plug if necessary. All types of motors are



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available for either grounded or ungrounded wiring systems. Formex wire and glass-insulated wire are used extensively throughout.

Typical applications served by the various frame sizes are suggested. The BA-25 frame motor is used to operate cowl flaps, oil coolers, landing lights, trim tabs, de-icer pumps, small blowers, and antenna reels. The BA-40 frame motor is suitable for operating fuel pumps, booster pumps, wing flaps, small hoists, and nose gear. The BA-50 is designed for the operation of bomb hoists, feathering pumps, landing gears, float retractors, and turrets. The BC-21 frame motor handles motor alternators, landing gear mechanisms, turrets, and cabin superchargers. Rounding out the line, the BC-31 frame motors are for the operation of large bomb hoists, large motor alternators, hydraulic pumps, and turret movements.

Buick Motors Division, General Motors Corp.

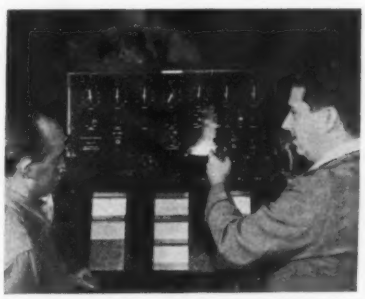
Helping to speed its production of defense items such as aircraft engines and parts, Buick Motor Division reports that it has eliminated virtually all delays incident to obtaining special tungsten carbide tools from tool manufacturers by producing such cutting tools—at a saving in cost—in its own plant in Flint.

Carbide tools, used largely because—in addition to saving tungsten—they have the ability to cut metals several times as fast as tools made of high speed steel, are produced at Buick by brazing standardized sizes of carbide tips to shanks of S.A.E. 1340 steel. While the carbide tips themselves are readily obtained from producers of tungsten carbide—such as Carboloy Co., etc.—the possibility of delays in obtaining complete tools is thus avoided by Buick.

Furthermore, in developing its carbide manufacturing program, Buick, through the G.M. Standards Committee found that all of its different carbide tools, for all classes of work throughout the Buick organization, could be produced from eleven different sizes of carbide tips thus simplifying materially the problem of tip inventory.

Carbide tools are produced by Buick in the following manner: Shanks are ground to size on all four sides from hot rolled stock on water type surface grinders. From here they go to the milling department where the recess for the tip is milled out and the shank is stamped, ready for brazing the tip in place. The tip itself is polished on bottom and contact sides with a diamond wheel.

For brazing, Buick has also developed an unusual setup which not only permits the use of city gas instead of requiring the usual oxy-acetylene torches, or electric furnaces, etc., but is also one of the fastest tool brazing setups ever developed. The brazing equipment consists of a fixture having a flat top, on the back of which have been attached six fishtail gas tips—arranged in such a position that the tool held in a vise, can be slid into position between three flames on each side. The vise itself rests on the flat surface of the fixture. The operator thus has both hands free with which to handle the tip and brazing material to assure getting a good braze. While one tool is heating the operator prepares another tool for the vise. City artificial gas is used to produce the flames, by mixing it with air through a venturi tube at each one of the jets. Adjustment of the tips regulates the heat.



Lockheed plant engineers inspect the newly designed electrical tester which reduces to fifteen minutes the 8 to 10 hours formerly required for checking the electrical equipment of an airplane.

Tool shank and tip are first cleaned by dipping in carbon tetrachloride. "Handy Flux" and "Easy-Flo #3" solder are then applied; the tool is clamped in the vise and the tip is placed in position in the milled recess and covered with flux to prevent oxidation. The assembly is then slid forward, bringing the tool into the flames in such a manner that the flames contact only the lower part of the tool shank. This avoids direct contact of the flames with the tip and brings the brazing end of the shank up to even soldering temperature (about 1,400°F).

As the tool heats up and approaches a cherry red, brazine wire is brought in contact with rear of carbide tip and allowed to flow under and round the tip. Using a $^3/_{16}$" rod with sharpened point, excess solder and air is removed by moving tip back and forth in recess of tool shank. The operator then brings the fixture back away from the flames, and while holding the tip firmly into the recess allows it to cool to a point where the brazing material solidifies. This is at around 1,175°F. for the "Easy-Flo" solder used. At this point he removes the tool, removes flux in hot water and passes on to the next one.

When the tool is cool it is shot-blasted and goes into temporary stock as a "milled and brazed" tool. From this stock it is drawn out for finishing of the profile of the tip to the required final shape in one of the numerous grinding rooms or service departments throughout the plant.

Lockheed Aircraft Corporation

In search for methods to cut production time on defense aircraft, the personnel of the Lockheed-Vega organization have made notable contributions, according to company officials. Among the more important recent inventions were a magnetic riveter for use on the Lockheed P-38 "Lightning," for which William Holcomb received a $2,500 second place Revere medal; the Onsrud Extrusion Miller, which was designed by the Onsrud Company in collaboration with the Lockheed plant engineering department, and which saves 87$^1/_2$ hours production time on the P-38; the development of a composite cable for aircraft control systems, by Carl Beed, Lockheed engineer, and a magnesium fire extinguisher, by Capt. R. B. Gottschalk and Michael Farris of the Vega Fire Department.

The newest invention, developed by John E. Browne, of Lockheed plant engineering, cuts the time required to check and double-check the maze of electrical installations in Lockheed airplanes from an average of 16 or 20 hours to only 15 minutes.

While working as electrical inspector in precision assembly over a year ago, Browne designed and had built by plant engineering a universal electrical tester that gives continuity, checks for shorts and duplicates operation of all electrical sub-assemblies equipped with special plugs. Since then he has revised the original design to meet new assembly requirements and the new machine is the finished product of his efforts.

The principle of the invention is based on the fact that the main switch box is the heart of an airplane's electrical circuit, the connecting link between all electrical equipment on the craft. Hundreds of wires pass through it, going from forward to aft, starboard to port. There are many plugs and receptacles with as many as 36 pins on one plug. But most important, there are about 100 loose wire ends which go out through various conduits to fuse panels and equipment.

It is these units which have presented a problem to production and inspection because it required many hours of work to check the continuity of the circuits. When so many wires were being checked and a man had to hunt for the other end,

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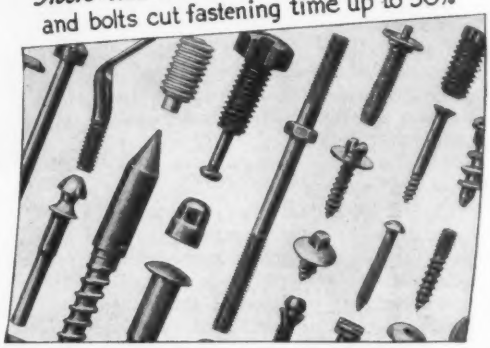
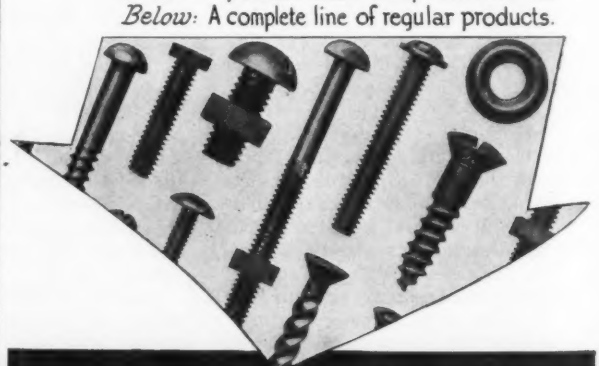


Above: Specials exact to specifications.
Below: A complete line of regular products.



CONTINENTAL SCREW COMPANY

New Bedford, Mass. *Warehouses* Detroit & Chattanooga

there were too many chances for mistakes if the job was hurried.

Consequently, these main switch boxes required considerable rework after they were installed, work which would have taken only a few minutes on the bench but required many hours after installation. Browne's idea was to literally transfer this bench testing to the installed apparatus.

His new tester does just this, in minutes as against hours. It checks all wires for shorts to the frame of the box and indicates by a red light those that are shorted. It also checks all plug terminals for shorts to the shell and adjacent pins, indicating by lights which are shorted and where. All switches in the switch box operate on the Tester the same as in the ship, and each switch has a separate light on the test panel to indicate if it is properly wired.

Progressive Welder Company

As the result of demand from the aircraft industry for portable resistance spot welding equipment for tack welding and assembly welding of sections in fixtures, where the work cannot be taken to stationary pedestal welders, Progressive Welder Company has developed a portable welding gun specifically designed for resistance spot welding of aluminum and its alloys.

The gun with its transformer may be used in combination with virtually any control equipment used for welding of aluminum. In order to facilitate production of various shapes of guns to fit specific manufacturing requirements, the new Progressive gun has all its operating mechanism built into a gun "head," which may be supplied with yokes to fit individual needs.

The new gun is air-operated, employing two differential cylinders in tandem, designed to produce a maximum point pressure of 1,200 lbs., when using normal factory airline pressure. For structural spot welding of aluminum, the gun will handle up to two pieces of 0.040-in. thickness. For tack-welding, greater thicknesses may be handled.

Incorporated in the gun head is a manually controlled point retracting mechanism, which permits retraction of one electrode to permit clearing of obstructions. The gun has a maximum stroke of 4 in. and is designed for the application of refrigeration to the welding tips. Refrigerating units recently developed for this purpose are effective in multiplying by several times the number of welds which can be made before the points need re-dressing, reducing both tendency toward pick-up and mushrooming.

The gun, in operation, is supported on a universal type compensating hanger, permitting positioning of the gun at any angle desired.

The new gun is expected to find a wide field of application particularly in initial spot welding operations on aircraft assemblies requiring tacking of small parts. Much of this work is handled in fixtures, obviating the possibility of using conventional pedestal type spot welding equipment. In addition, of course, it can be used for assembly welding of parts too large to handle in pedestal welder.

Slayter Electronic Corporation

A new line of high voltage rectifiers has been announced by the manufacturer, Slayter Electronic Corporation. They are designed to meet the requirements of both the production line and the laboratory. The rectifiers embody the results of several years of research and are said to provide a degree of compactness and flexibility never previously attained in high voltage rectifier equipment.

Slayter Electronic rectifiers are available in 20, 50, 100, and 200 kilovolt units, with a current range from microamperes to milliamperes. The entire unit is housed in a grounded metal case, with all the necessary metering devices built in as an integral part of the case.

Small and light for the voltages produced, the units are readily portable, eliminating the need for a special chamber and permanent installation for even the 100 and 200 kilovolt units. The 100 kilovolt, 1,000 watt unit, for instance, measures 3 × 3 × 6 ft., weighs 450 lbs. with all controls, and can be moved with ease and safety.

On all standard models the polarity of the unit can be reversed in a few minutes. The units can be turned on and used immediately, without waiting for "warm up," and can be operated continuously on full load. They can be supplied to provide substantially no "ripple" or large amounts of "ripple," depending upon the needs of the user. All of the units can be operated from an ordinary 110-volt light socket, by merely plugging into the socket.

On the production line the new rectifiers are expected to find application whenever the need exists for converting alternating current into high voltage direct current at low current capacity. In the research and testing laboratory the rectifiers will serve not only as converters of current, but as a means of solving problems associated with electrical machines.

Many laboratories are equipped with Slayter rectifiers and are currently employing these in a study of electrical disturbances in aircraft. The device also has proved itself to be important in testing aircraft ignition cable. The small size and light weight of the new rectifiers offer decided advantages in the aircraft field. The 20-kilovolt rectifier, measures approximately 13 × 10 × 15 in. and weighs 25 lbs.

The units are air insulated, eliminating the weight and expense of oil, as well as the fire hazard. The use of tubes of the cold cathode type instead of the hot cathode type tubes, and the fact that there are no filament leads or filament transformers, add to the simplicity of the units and their ability to stand up under hard usage. No heating current is necessary as there are no filaments to heat up.

Temporary arcing or line surges do not affect the Slayter rectifiers, and they can be short circuited for a much longer time than that necessary to trip a relay, without damage.

Weltronic Corporation

A completely self-contained radio telephone combination transmitter and receiver weighing four pounds, and not much larger than the handset of a French telephone, has been announced by the Communications Division of Weltronic Corporation. The built-in battery power supply for the new Weltronic "Trans-Ceiver" under continuous operation has a rating of about 8 hours. This is equivalent to approximately a week to a month's operation under "normal" intermittent service. The power supply is derived from standard commercial batteries in order to keep battery replacement cost at a minimum and facilitate maintenance of operation.

With a range of upwards of a mile over land, the units are provided with off and on switches and finger operated selector to change from transmitting to receiving and vice versa, while talking through the unit. Although the Weltronic "Trans-Ceivers" are designed for operation on a single wave length, thus requiring no tuning in service, their frequency range is adjustable from 112 to 300 megacycles through a simple externally accessible screw adjustment. Also provided on the units are a volume control and a detachable adjustable short fish-pole type of aerial.

In operation, when the toggle switch is thrown into the "on" position, the unit is "receiving." To talk through the unit, it is necessary merely to put the selector finger lever down against light spring pressure. Releasing the selector lever switches the unit back to "receiving" again. The Trans-Ceivers may thus be used in pairs or groups with or without a central receiving and transmitting control station.

Westinghouse Electric and Manufacturing Co.

Before the aircraft pilot is a score or more of indicator lights. If they are bright enough to be clearly distinguished as on or off during a bright day they will blind him at night if he shifts his gaze from the inky blackness outside to the cockpit. One remedy has been to control the brilliance by inserting resistance into the circuit, but this has required rheostats as bulky and heavy as the lamps themselves.

A method of brilliance control developed by Westinghouse adds neither weight nor bulk to a crowded instrument or radio-control board. Two layers of Polaroid are placed between the bulb and the lens; one is fixed in position, the other can be rotated by turning the lens. The stationary Polaroid screen polarizes the light in the horizontal direction; it blocks all light waves from the lamp except the horizontal. The rotable Polaroid can be oriented to allow the horizontally-polarized light to come through, or, when turned 90 degrees, to block them. Thus the pilot can obtain from the indicator light any brilliance from full brightness to almost complete darkness by simply rotating a collar on the indicator.

Eight years ago engineers proved that ordinary incandescent bulbs, covered with a shield to sift out all but invisible ultraviolet rays, could be used in nearly complete darkness to light up airplane instrument dials coated with a fluorescent paint. Today, instead of an incandescent bulb, the light source is an ultraviolet lamp about the size of an automobile headlight bulb. The lamp burns only four watts and operates from the airplane battery.

The rotatable poleroid type of indicator lamp, developed by Westinghouse for aircraft radio sets.

Energy is first caught in the lamp by mercury vapor which transforms it to a wavelength of 2,537 Angstroms. This energy is picked up by a fluorescent coating on the inside of the glass which transmits it at 3,650 Angstroms, still too short to be seen by the human eye. Light at this wavelength, falling on luminous paint on the instrument dials and needle, is converted to visible light too soft to blind dark-accustomed eyes. It would be possible to use dial paint that responds directly to mercury vapor but the efficiency of transmission through the cover glass of the instrument is extremely low.

In the new aircraft engine plant of the Ford Motor Company, engines are built by the power developed in testing them. In the past the engines wasted their power into the air by driving special propellers during their green and final tests. Not only is this wasteful but also creates problems of noise and heat elimination.

The Ford Motor Company has installed sixteen Westinghouse 1,250-kva 720-r.p.m. synchronous generators. Each is connected to an engine through a hydraulic slip coupling, arranged so that when the engine speed exceeds 720 r.p.m. the generator runs at constant speed and delivers power to the plant alternating-current bus. Sufficient power is recovered in this manner to supply a large percentage of that needed for the manufacture of the engines.

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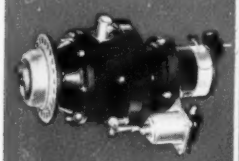
AIRCRAFT ACCESSORY EQUIPMENT

STARTING EQUIPMENT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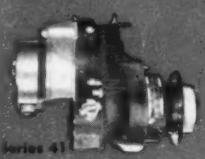
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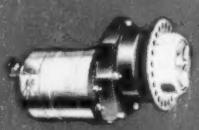

A-160 Electric

Combustion

Hand Turning Gear

Solenoid Relay

Booster Coil

Control Switch

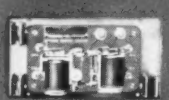
GENERATING EQUIPMENT

DC Generator

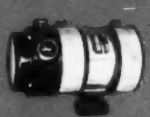
AC-DC Generator

Detachable Control Box

Standard Control Box


Control Panel

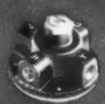
Filter Box


Booster Dynamotor

Radio Dynamotor

AIR PUMP AND DE-ICER EQUIPMENT

Air Pump


Suction Regulating Valve

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